









Vol IV wants title page and Index



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### NOW READY.

## "Artesian Borings in the Sunderbunds."

As the issues of the journal containing the articles headed as above are out of print, and sufficient inducement having offered, the matter has been reproduced in pamphlet form to meet the requirements of District Officers and others in Bengal and elsewhere.

Price Rs. 2 per copy.—Cash.

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# INDIAN ENGINEERING.

SATURDAY, JULY 7, 1888.

## CIVIL ENGINEERS IN INDIA.

AN article under this heading in the *London Engineer* cannot fail to have a deep interest for the men to whom it refers as being possibly the exponent of the feelings of the profession, or the public at home, towards a body of deserving public servants whose existence is hardly known in England.

Being perhaps more behind the scenes than the *London Journal*, we must confess to a feeling of disappointment in the article of 1st June, which appears to be considerably inspired by "the Indian official of high rank" referred to therein; the accuracy of whose knowledge is not what might have been expected.

We read in his reply to a query as to the cause of the non-success of the Public Works Department in enforcing its claims for better treatment, that the Civil Engineers "have often directed all their energy to bringing the military men down to their own level of pay, or of driving them out of the Department."

Now as regards this statement, from what we know of the case, it is not true that the Civil Engineers have ever devoted their energies to damaging their military brethren. Our impression is that they have often agitated to be levelled up to the military men, but not for the latter to be levelled down.

They have often claimed an equal share in the loaves and fishes, few as they are, of the Department, but have not objected to the military men retaining their share also.

Again we read, "They claim to form a profession as honorable as that of the law. But where is their professional etiquette, their *esprit de corps*, their mutual toleration? \* \* \* We never see one part of the legal fraternity petitioning Government to reduce the emolument of another part."

Here the logic of the official seems a little at fault. As the legal profession is not in the hands of Government, they cannot well be petitioned on the subject, and as the appointments made in it by Government are within the reach of all alike, there is no object in petitioning. What parallel can be drawn between a profession open to all alike, and a Government Department, the very constitution of which absolutely precludes *esprit de corps*, by maintaining invidious distinctions that have accidentally arisen in its gradual development?

The Civil Engineers do not enter the Department with their eyes open. It is only after they arrive in India, that they find out the constitution of the Department, and the inevitable result of seeing that a certain section enjoy privileges from which they are debarred, is to cause jealousy and discontent.

It is indeed to be regretted that there should be any "washing of dirty linen" in public, but it certainly is



not true as insinuated in the article, that the body of the Civil Engineers indulge in this occupation. Ill-tempered letters from individuals have from time to time appeared, purporting to set forth the shortcomings of R. E's, but in many cases these have even been repudiated by other writers, and cannot be justly charged upon the whole body, who have only claimed to be equal with the R. E's.

We shall always endeavour to hold an even balance as an organ of the Engineering profession in India, not of any section in particular, but it is impossible in discussing such a question to avoid the old grudge between C. E. and R. E., and the concluding paragraphs of the article we review compel us even to introduce a personal element into the discussion, which we would rather have avoided, but it is necessary to shew in what different aspects a question may be regarded.

Referring to the honor lately conferred upon Sir J. Browne, R.E., the writer says: "See the insane way the P. W. Department act at the very moment when a disposition is shewn to redress their grievances. A distinguished military member of this body, one who has worked with them for thirty years \* \* \* is knighted in recognition of purely Engineering services, and as a Public Works officer only \* \* \* One would imagine, that they would receive the honour with pleasure \* \* \*. But instead of this they raise an agitation against Sir James Browne, simply because he is a military man \* \* \*. That he has spent two millions too much on the line; that the surveys were bad and the wrong route was chosen \* \* \*"

Now considering that the very complaint of the C. E's. is that the R. E's. are better off, not only in pay, but specially in monopolising high appointments and honors, it is difficult to see how a reward, however well deserved, conferred on an R. E. gives *them* any better hope of success.

They do not object to it so far as the individual is concerned, and personally may even be pleased to hear of his success, but so far from holding out to *them* any hopes of similar success, it is only another instance of how the R. E's. somehow manage to get the plums.

The last paragraph we have quoted is a positive misrepresentation. It is absolutely untrue that there has been an agitation against Sir J. Browne *because* he has been decorated or even because he is a military man.

There have previously been from time to time remarks made in different journals, and even in our own columns, (from which we saw no particular reason for excluding them,) about extravagance and incompetence in connection with the Sind-Pishin Railway. The wisdom of the alignment was doubted, and the extravagance generally believed in, and the natural result was to saddle the Chief Engineer with these shortcomings, without remembering that a Government official has to do many things against his better judgment.

We conclude that unless most high Indian officials are better informed than this one as to facts, and as to

the ideas and wishes of the Civil Engineers, redress is indeed far off.

## TIDAL OPERATIONS IN INDIA.

### II.

In a resolution of the Government of India, dated 4th July 1877, the Governor-General in Council observes "that the great scientific advantages of a systematic record of tidal observations on Indian coasts have frequently been urged upon and admitted by the Government of India. Hitherto the efforts in the direction of such a record have been desultory, and in many cases wanting in intelligent guidance and careful selection of the points where the observations should be recorded. Additional importance has recently been given to the subject by the institution of a Marine Survey Department, for whose operations accurate tidal observations are a necessity, without which no permanent record of the changes of ground in the different harbours of the coast can be kept up. The advantages to be expected from well considered and carefully conducted observations of the tides are mainly the following:—(1) They enable standards to be fixed for the purposes of survey. (2) They afford data for the calculation of the rise and fall of the tides and thus subserve the purposes of navigation. (3) They are of scientific interest apart from their practical usefulness." It was therefore decided to set up self-registering tide-gauges and meteorological instruments at various ports on the coasts, and in order that the expense might be met in a manner proportionate to the practical and scientific advantages derived from the observations, it was settled that the various ports should, when possible, pay for the establishment and maintenance of the instruments, and that an officer of the Government of India should supervise and control the local observations. Captain Baird, R.E., Deputy Superintendent in the G. T. Survey Department, was entrusted with the general superintendence and control of the observations, and instructed that he should be guided by the orders and advice of the head of that department.

The operations were commenced in 1878, and it was decided that certain stations, *viz.*, Aden, Karachi, Bombay, Madras, Kidderpore, Rangoon and Port Blair should be considered permanent stations, that is stations at which the observations shall be continued as long as the operations are continued, while the other stations should be considered minor stations at which 5 years' observations shall suffice. Up to the present the observations have been completed at 10 minor stations, and are being continued at 11 others.

The self-registering tide-gauges with which the registrations are taken at various ports, though differing slightly in detail are practically similar to each other. There is first of all a cylinder generally 2 feet in diameter, and sufficiently long to ensure its lower surface being below lowest low water, and its upper surface above highest high water. It may be either placed in a well made for it on land, or it may be in the sea. In the former case, it is connected with deep water by means of a pipe of suffi-



cient diameter to ensure the water being at the same level inside and outside the cylinder: in the latter case, the water is generally admitted through holes drilled in the lower end of cylinder. A float made of copper, a foot in diameter, and 9 inches high, rises and falls in the cylinder as the water rises and falls. To its upper surface is fastened a copper band 1 inch in breadth, pierced at equal intervals with holes which fit on conical studs set on a brass wheel. The band is long enough to extend about 5 feet beyond the stud wheel after passing over it when the float is at its lowest position, and a chain of weight equal length for length to that of the band is attached to it, and to the under surface of the float. The float is balanced by a weight attached to this chain. The stud wheel is geared by means of 2 cog-wheels to a fourth wheel, and round this a flexible chain is passed, the free end of which is fastened to a traveller which carries a pencil, and which moves between 2 horizontal brass plates; to the other side of the traveller a weight is attached by a cord passing over a pulley so as to ensure the pencil moving in both directions, and accurately recording the rise and fall of the water. A drum 5 feet 3 inches in length, and 24 inches in circumference is placed directly beneath these two plates; it is supported on a cast-iron bed-plate and driven by clock-work. A diagram is pasted on the drum, and the movement of the pencil due to the rise and fall of the water combines with the motion of the drum to form a curve on the diagram. The 2 cog-wheels are constructed in couples to enable the working scale of the tidal diagrams to be varied from the full scale to that of  $\frac{1}{8}$ th, so that tides up to 40 feet may be registered. Two grooves about  $\frac{1}{16}$ th of an inch deep are cut into the drum, one near each end, and exactly 5 feet apart, and a third is cut midway between them. The groove at one end is adopted as the zero-line of the gauge, and when the diagram is fixed the zero, middle and end lines are indicated on the paper by rubbing over the grooves with a hard pencil. The zero-line is tested at each inspection of the observatory by sets of zero measurements, that is, measurements of the absolute depth of the water below the bed-plate combined with the position of the pencil on the barrel, and, if necessary, the diagram is corrected. The bed-plate is supported on trestles and carefully levelled; it is also connected by spirit-levelling with bench-marks built on the land, and its height is tested at each inspection.

The other instruments in connection with the observatory are a self-registering aneroid barometer which registers the hourly heights of the barometer by means of a metallic pencil marking on prepared paper; a mercurial barometer for comparing with the aneroid; and a self-registering anemometer marking the direction and velocity of the wind on prepared paper by means of spiral pencils. Outside the observatory a graduated staff is fixed vertically in such a position as to be easily read, so that a comparison of the level of the water outside and inside the cylinder may be readily made and retardation of the flow of water into or out of the cylinder detected.

(To be continued.)

## THE WORKING OF THE GEOLOGICAL SURVEY

PART 1 of Vol. XXI. of the *Records of the Geological Survey of India* opens with the Annual Report for 1887 including the Calcutta Museum affiliated to it.

Dr. King, the Director, complains that on taking over charge of his office last year he found the working staff lamentably under-manned, partly because of vacancies long unfilled, partly because many officers had been detached for special work. Two of the vacancies have since been filled up, Dr. Nöetling (Berlin University) being appointed Palæontologist, and Mr. Philip Lake (Cantab.) Assistant Superintendent. Of the absentees, Mr. Mallet had a year's leave on sick certificate, Mr. Hughes was on deputation with the Deccan Mining Company, Mr. C. H. Griesbach's services have been placed at the disposal of the Foreign Office for two years, for employment as Geologist to the Ameer of Cabul. This last deputation seems to us notable, and of hopeful augury. So is the statement that rulers of Native States are beginning to indent upon the Department for the services of its officers on special enquiries in connection with geological formations, and their possible utilization. The Director plaintively laments that the departmental services proper of these officers can ill be spared.

The obvious moral is that the strength of the Department should be reinforced, added to. When native princes are in the unusual humor of encouragement to geological research in their States, it would be a thousand pities to discourage them and their widenings of the field open for scientific exploration. We presume that they pay for the services they take advantage of: it is written that those services are appreciated by the Durbars to which they are rendered.

As to dispositions of departmental work, Mr. Foote was in charge of a field of enquiry embracing the whole Madras Presidency, with its immense area of crystalline rocks or gneisses. At present the great interest attaching to this series of transition rocks "is not so much that it may fall in with or represent some or all of the various transitional formations of Central India \* \* \*

\* \* \* but that it is the series in which auriferous reefs are more particularly developed in the Madras Presidency." By virtue of his Southern Indian experiences Mr. Foote has become the best "gold man" in the Department. This is interpreted as meaning in English not that he is an expert in the common acceptation of the term, but a geologist experienced *par excellence*, in the kind of rocks, or the particular formation likely to be auriferous in India. A very superior creature to an expert, in short. Just the sort of transcendental medium likely to be in request now that Sir Roper Lethbridge and other like-minded people, who plume themselves on their commonsense, have given guarantees of fecundity to the gold-fields of Southern India. We feel quite disappointed at finding no oracles from Mr. Foote on the subject of Mysore diamonds. According to latest heard of hopeful expectation the South Indian gold-fields are naught unless diamondiferous also.



The Director of the Survey devoted himself to "boring experiences" in the Chathisgarh coal-fields, results shewing that throughout the country to be traversed by the Nagpur-Bengal Railway there is only one tract, near Korba, at all worthy of consideration as a likely find for workable coal of good quality. Experiment has shewn that it "does not change for the worse to the deep," as has happened in other parts of the area exploited. *Appropos* of the singularity Dr. King writes:— I could not but marvel at this disparity between boring and outcrop samples, which certainly seemed to shew that the boring samples might not be so free from admixture with shales as one is generally led to expect in work of this kind. Under these circumstances, and considering the interests involved, I have felt bound to recommend small trial pits as the readiest method—in the difficulty of getting improved boring plant or trustworthy workmen—for ascertaining the quality of the coal in bulk. Such pits are to be tried near Hingir and at Korba; and further borings should be put down on Hira Lal's seam at Gordhewa to ascertain the area of that field.

Rajputana has been for many years Mr. Hacket's area, and he is reported as still in it, working out details of the very puzzling and complicated relations of the several series or groups of transition rocks. Up to the close of last season his work lay in the neighbourhood of Mount Abu. It is departmentally hoped that his investigations may be prompted to a westward direction, and a field for exploration which may be made to include the economically interesting Gondwanas, with their coal possibilities.

Mr. Oldham has been considerably knocked about. Having completed the work he was set to do in the Salt Range, which included a visit to the Dandot coal-mines, he proceeded to Simla, preparatory to making an expedition to Ladak and back by Kashmir, according to the desire of Mr. Medlicott with a view to determining how far the discrepancies between the sequence of beds in Kashmir, as described by Mr. Lydekker, and that of the Simla region were real. On return from other work early in November, he was deputed to look up the prospects of obtaining petroleum at Tijarah, near Ulwar. His report confirms the previously entertained departmental idea that the bituminous stuff obtained from Tijarah is merely an occurrence of combustible organic matter in a thin layer, or seam, associated with potsherds and other refuse formed on the site of an old cattle village.

The Kashmir Government deprived the Department of the services of Mr. La Touche, who had to abandon his work in Assam, and traverse the continent in order to hunt for sapphires for the Durbar, in the Zanskar district. Sapphires he did not find. The snow line and inclement weather were against him, and he had to give up his jewel exploitation till a more propitious season. Meanwhile his talents were turned to account in examination of the Jammu coal, originally discovered by Mr. Medlicott. On this he inclines to look with a favorable eye—provided some method can be devised similar to that adopted in Italy, for compressing the crushed and powdery fuel into bricks. Perchance, after all black

diamonds may pay the Kashmir Durbar better than sapphires would.

The geological and mineralogical galleries at the Museum are reported in perfect order, and the collections are being gradually added to by presentations, and by exchange with American, Continental, and British societies and collectors.

### ADVANCE INDIA.

HOWEVER much opinion might be divided in regard to the soundness of Sir. W. W. Hunter's views on the National Congress, or the more extended adoption of the representative element in the Imperial and Provincial Councils, there can be no doubt that his utterances on some of the economic problems, on which depend the material improvement of India, are certainly entitled to respect. The late Director-General of Statistics, from the very circumstances of the case, is quite at home in such matters, and although his speech at the monthly meeting of the Royal Colonial Institute, on "The New Industrial Era in India," was a mere statement of facts, yet how very few writers of the present day, cognizant of India and her history, could bring within the compass of a nutshell, as it were, the important changes that have been effected during the last two centuries of her annals. If our native friends, who are clamouring for more power in the management of their country's affairs, would seriously think of what Sir W. W. Hunter has written, they would entertain the same opinion as we do, that the prosperity of India depends more upon developing the unbounded resources than in enjoying the privilege of a seat in a Legislative Council.

We have only to take a bird's-eye view of what this land was in ancient times and what she is now. Centuries ago she was a dealer in trinkets and curiosities, sending them no further than the shores of the Levant, at a heavy cost of carriage, while now she is a keen competitor with America, as well as with England and other countries of Europe. Can this be said to be a trifling gain, and all consummated within a couple hundred years. If the English are called a nation of shopkeepers, they could with justifiable pride point to the establishment of an Empire as the result of trading proclivities. During the first quarter of the last century the annual imports into England by the East India Company were valued at three quarters of a million sterling, and consisted of calicoes, other woven-goods, silks, diamonds, spices, drugs, and saltpetre. Of the Company's exports to the East they barely exceeded half a million sterling annually, of which value 80 per cent. or more were made up of bullion. This was at a time when the East Indian trade was a monopoly in the hands of the Company; a little more than a century when the latter was removed and the commerce thrown open to the world, that is, in 1834, the exports from India were valued at 9½ millions sterling. It now commenced increasing by leaps and bounds, and towards the end of the next twenty years they went up to 20 millions for the 5



years ending 1854. Within another couple decades, which era marks the introduction of Railways in India, the expansion of steam shipping *via* the Cape, and subsequently the opening of the Suez Canal, the Indian exports of merchandise rose to an average of 57 millions for the five years ending 1874. The next ten years witnessed a development of trade which perhaps has no parallel in the history of the world. The imports expanded to 88 millions sterling; and yet complaints are heard on all sides of the deep poverty of India. To shew at the same time how the carriage capacity of the trade improved if we look into figures we will find that the tonnage of the larger number of vessels in 1874 was only 4½ millions, against 7 millions in 1884. The number of steam vessels (entered and cleared) had nearly doubled from 1,627 in 1874 to 3,094 in 1884, and their tonnage had more than doubled from 1¼ million to over 4 million tons.

All these happy results would not have been brought about but for the great expansion of the Railway system in India, which alone has rendered it possible for the new Indian staples to reach the sea, and to be laid down in Europe at a much cheaper cost than the products of any other country. In former years, when this state of things did not exist, a fruitful season was as much of a calamity as a drought, because there was no outlet for the produce of the soil, which had to be sold locally for whatever they might fetch. But happily those times have been numbered with the institutions of the past, and the larger the production of the Indian fields, the larger are her exports. But this is not all her gain. Who ever dreamt that before the present century came to a close, India would rank as a competitor with England in her own arts and manufactures.

There was a time when fears were entertained that in the matter of silks and cottons, the textiles of this country would destroy the trade of England, but with the development of steam machinery in the beginning of the present century the tables were turned. The hand-loom of India was crushed out by the outturn of the Lancashire factory, and Indian weavers were threatened with destruction. The latter were absorbed with the other classes, and for a time there was great suffering among them. But India was not to sit quietly with folded hands while the other nations were participating in mechanical appliances. In 1854, the first mill for manufacturing cotton yarn and cloth was set up in Bombay; within thirty years there have been over 100 cotton and jute mills at work throughout the country, with 22,000 looms, 2,000,000 spindles, and giving employment to more than 100,000 persons. Instead of sending raw material to England and getting it back manufactured, thus paying double freight, here we have the means at our disposal, if we would only face the subject boldly, of converting our own products into manufactured articles, and instead of depending upon England, we might be her rival, as it is to a certain extent in China, Japan, and other Eastern countries, where we now can lay down cheap cloths at a much more remunerative rate than England can, and obviously, owing to the distance of her scene of operations.

## Notes and Comments.

**MU VALLEY RAILWAY.**—It is very probable that the survey for this line in Burma will be started in November next.

**JETTY WALL AT NEGAPATAM.**—A revised estimate, amounting to Rs. 17,590, for extending the jetty wall at Negapatam, has been sanctioned.

**ANOTHER EXPLOSION AT ADEN.**—A magazine of the new sort containing gelatine exploded on the 28th June. A native sentry was blown to pieces. The damages are trifling.

**MR. W. J. ADDIS.**—The veteran Engineer of the Bassein Municipality, in Burma, having taken leave for 6 months, a *locum tenens* has been entertained on Rs. 300 per month.

**INDIAN PATENTS' OFFICE.**—The work relating to "Patents," which has hitherto been dealt with in the Home Department of the Government of India, has been transferred to the Revenue and Agricultural Department.

**THE LATE P. W. D. SECRETARY, UPPER BURMA.**—Major T. Gracey, R.E., having made over charge of the Public Works in Upper Burma to Colonel W. G. Cumming, R.E., leaves Bombay on 10th July on his well-earned furlough.

**THE STORY OF MR. FURNIVALL'S SHARES.**—We agree with the Hyderabad-Deccan paper that, having regard to Mr. Furnivall's past career and reputation, the proper answer to his explanation would be that no explanation was either necessary or called for.

**TRAMWAYS FOR RAWALPINDI.**—Government has sanctioned the construction of tramways in the cantonment and the district of Rawalpindi, and the work will shortly be taken in hand under the direction of Mr. John Attfield. The lines are to run through the principal streets of the cantonment and the city.

**THE MADRAS HARBOUR.**—The Madras Harbour Trustees called the attention of the Government to the very great delay which has occurred in disposing of the question of a design for the new entrance to the harbour, entailing an enormous waste of money for a large establishment which cannot fully be utilised.

**SIND-PISHIN RAILWAY.**—A Correspondent wires to inform us that three forty-foot spans of this line were washed away by a small flood of eight hours' rain. A similar washaway took place last year. In both cases the bridges were found to have no foundations! This is a glowing comment on the recent articles in *London Engineering*.

**ASSAM-BEHAR RAILWAY.**—The construction work of the Kosi Extension Division of the Assam-Bihar section of this line is being pushed on. The bridge works are expected to be finished before the rains set in. The Kosi line is under the direct supervision of the Executive Engineer, Ganges Division, who is assisted by two able sub-divisional officers.

**AN INDO-AUSTRALIAN TELEGRAPH CABLE.**—The Crown Agents for the Colonies have, writes a London correspondent, decided to enter into a contract for the laying of a telegraph cable from a point on the coast of Western Australia to India or Ceylon, so as to be in connection with the Indian telegraph system. The sole right to work the cable will be conceded for 21 years.

**NOT SATISFACTORY.**—In the report of the Directors of the Madras Railway Company, it is stated that the gross



revenue for the half-year ended December last, was £366,663 against £371,200 in the corresponding period of 1886, while the expenditure was £243,401 against £228,475. The net income has consequently been £123,262 compared with £142,725, or a decrease of £19,463.

**IRRIGATION IN SIND.**—Altogether the past year was a most satisfactory one for the irrigation system in Sind. There are in all, 5,824 miles of canals and 602 miles of embankments for irrigation purposes in Sind, but it seems somewhat strange that capital accounts are kept for only eleven systems, which comprise 2,549 miles of canals and 229 miles of embankments.

**THE MYSORE AGRICULTURAL AND INDUSTRIAL EXHIBITION, 1888.**—The Industrial Arts Section of this Show comprises—I. Hardware and Cutlery, II. Earthenware, III. Glassware, IV. Furniture, V. Basketware, VI. Textile Manufactures, VII. Leather, VIII. Stationery. The Exhibition will be opened at Mysore on the 15th of October, current year, and will continue for four days.

**MINERAL PROSPECTS IN CABUL.**—The latest news of Mr. Griesbach was that he had gone to Hazarajat. So far as is known, he does not seem to have yet discovered any signs of coal or precious stones, but it may be that he has refrained purposely from communicating with India on the subject. Nevertheless, we are in a position to state that extensive orders for Mining Plant have been executed for the Ameer at home.

**BUILDING IN SINGAPORE.**—The bungalow, the typical style of eastern construction, is fast disappearing in the Straits capital. A few examples are built here and there, just to prove, as it were, that it is not altogether quite extinct. The increased value of land compels people to "go up higher," in order to obtain that habitable accommodation which, under other circumstances, would have been spread over a more extended area.

**THE OUDH AND ROHILKUND RAILWAY.**—The Board of Directors of this line, anxious to preserve connection with work which has engaged their interest and attention for twenty years, have offered to consider with the Government whether some arrangement could not be made by which the Company may undertake extensions of the Oudh and Rohilkund Railway system, and the working of the existing lines, but no decision has yet been arrived at in the matter.

**DOWNTON AGRICULTURAL COLLEGE.**—A communication was recently received by the Government of India from the President of the Downton College of Agriculture, relative to the desire of that institution to obtain a share of Government patronage as regards Indian agricultural students; and, as it is held that the diploma of the Downton College may be accepted as of equal value to that of the Royal Agricultural College at Cirencester, the former will, we hear, be admitted to a share in the patronage of Government.

**UNFAIR COMPETITION.**—The *Statesman* says that the attention of the Bengal Coal Companies has no doubt been directed to the probability of their having to compete at no distant time with the Umaria Collieries in the supply of the Rajputana-Malwa, the Oudh and Rohilkund, and the North-Western Railways. This colliery has made a long stride in reducing the price of its coal from Rs. 10.5 per ton in 1886-87 to Rs. 4.27 per ton in 1887-88. But we may add that all this has been accomplished at public expense, and the figures are deceptive.

**THE SUPERINTENDING ENGINEER VACANCY IN BENGAL.**—Mr. Anley's successor is not yet known, but Colonel Neill, who is the senior, is not willing to vacate his present post, for which he has a special aptitude, and from which he can ill be spared—considering that a man of tact, experience, determination, and even temper is necessary for such an important post. Mr. Nightingale is in the run; he is considered an active, pushing officer, who has proved his special fitness for the performance of the administrative duties entailed by the higher appointments in the P. W. D.

**ROAD BRIDGES IN SOUTHERN INDIA.**—The Madras Government accept the proposal of the President, South Arcot District Board, that the reconstruction of the Ponnar and Gadilam Bridges should be undertaken by Government, and that the Public Works Department should depute a special officer for the work. The Ponnar and Gadilam bridges, in South Arcot, were destroyed by the floods of 1884. The estimates for both bridges have been sanctioned by Government in the Public Works Department, and each amounts, in round numbers, to Rs. 1,66,000.

**SIR CHARLES ELLIOT AND "OURSELVES."**—A Correspondent writes:—"I notice your rival has succeeded in getting the Government of India to purchase 200 copies for one year and our Province is to be afflicted with 15 or 20 copies. I hope you have the same encouragement." *Discouragement* would more aptly describe the attitude of the Government of India towards this Journal. Its fair, fearless, and free policy does not find favor with a certain section of "officialdom." Nevertheless, we firmly believe in light and publicity, and will persist in the exercise of the right of open criticism.

**JOBBERY AND CORRUPTION.**—The *Indian Daily News* writes:—"Sir Charles Elliot has given mortal offence to one of the two professional engineering journals published in India. INDIAN ENGINEERING contrasts the professed zeal of the President of the Finance Committee in the cause of economy and retrenchment, with his action in having 'gone out of his way to subsidise a rival journal at the cost of the rate-payers, by taking in, on behalf of the Government, 200 copies of that paper from the 1st July next.' These paper subsidies, whatever form they take, have a close affinity with jobbery and corruption in many cases, and are not to be encouraged."

**RAILWAY ECONOMICS IN SOUTHERN INDIA.**—Messrs. Parry and Co., of Madras, drew the attention of the Government to the privileges which the South Indian Railway are according to Pondicherry merchants, in the matter of carriage of ground-nut kernels to the detriment of shippers from British ports, in a very strong protest. But the Agent shewed special cause for the rate to Pondicherry, and also that Cuddalore still has a considerable advantage over Pondicherry. Thereon His Excellency the Governor in Council is of opinion that in this particular instance the special rate accorded by the Agent, South Indian Railway, has been justified.

**INDIAN MIDLAND RAILWAY Co.**—The Board are in communication with the Secretary of State in the matter with the object of effecting a transfer to this Company of the working of the Bhopal line from the G. I. P. Railway Company, who at present work it for Government, so that this Company may take up the working of the line through from Itarsi, on the G. I. P. Railway, to Bhopal, at the same time as the section of the Company's system from Bhopal to Bhilsa, which is now completed, is opened for



public traffic. The Board are also in communication with the Secretary of State with reference to the terms upon which it may be proper to obtain the transfer to this Company of the Sindhia State Railway.

**THE PROPOSED NORTH-EAST ENTRANCE TO THE MADRAS HARBOUR.**—The Port Trust recently resolved, with reference to the alterations of design proposed by Sir G. L. Molesworth, that their Engineer be requested to report whether the amended plan will not necessitate a great deal more of the old work being taken up, and therefore involve further delay and enhanced expenditure. The result is that Sir Guilford Molesworth's modified plan for the entrance to the harbour works having been examined by the Engineer of the works, the Trustees have come to the conclusion that the additional protection afforded would not justify the expenditure and delay.

**DEPRESSION AFFECTING ARTIZAN CLASSES IN AUSTRALIA.**—Advices received from Sydney state that there is at present considerable decline in the demand for artisans and mechanics in the Colony, due to the ever-increasing immigration from the British Isles and elsewhere. Building trade has dwindled into insignificance from its heretofore large proportions, throwing out of employ thousands of people consisting of laborers, artisans and mechanics, who in desperation have taken to selling of milk and other less remunerative avocations. The remedy has, we see, been partly found in the refusal by the various local authorities to permit John Chinaman entering the Colony to cut out his European brethren. This would seem to argue against the belief of Rajah Brookes that "without the Chinaman we can do nothing."

**THE CIVILISING INFLUENCE OF THE "METALS."**—Judging from the very interesting and instructive account of the Trans-Caspian Railway by Dr. O. Heyfelder, Councillor, St. Petersburg, it would appear that, apart from the military and strategical reasons, which led to its conception and construction the line has in its onward progress to completion, singularly fulfilled the prophetic forecaste of Prince Gortschakoff contained in his circular despatch of December 1864. The construction of the line has been the means of protecting millions from the raids and annoyances of their savage or semi-barbarous neighbours; of showering the blessings of peace and prosperity on the tribes under the Russian sway; of raising villages in wild wastes; of forming provinces of places under perpetual rivalry of arms as to their limits, and of giving security to person and property.

**THE GOVERNMENT AND THE PRESS.**—The *Poona Observer* writes:—It is lamentable to find that those in high places can descend, at times, to exhibitions of human weaknesses scarcely worthy of them. We have before us particulars of a case, in Calcutta, in which the interests of two newspapers are concerned, but in which the Supreme Government have shewn a strange and inexplicable partiality to one. Setting aside the question about this very questionable arrangement being prejudicial to the other organ, there is a very apparent perpetration of "jobbery" which ought to be taken notice of. If justice is not done, the Newspaper Press in India ought to combine and demand their rights. This is a most shameful instance of partiality, and we should not be surprised to hear that some underling has been at the bottom of it. Seriously speaking or writing—the Press of India ought

to support INDIAN ENGINEERING in the gross injustice done to it.

**TRICHINOPOLY WATER-SUPPLY.**—The South Indian Railway authorities are contemplating to get their supply of water from the Cauvery through piping laid on their own bank, as their present supply from the Woyacandan channel constantly fails. Their estimate, it would appear, amounts to Rs. 70,000. It is suggested that Government intercede in the matter and induce the Railway authorities to come to an understanding with the Municipality for the work (water project), which would thus be not only finished soon, but very economically. The Railway Company could no doubt undertake to carry out the work to suit their own purpose as well as that of the Municipality. The Municipal Council can either pay the total cost proportionately by instalments, or contribute a fixed sum to the Company every year as compensation for the money laid out by them for the work. The latter course will avoid the difficult task to the Municipality of raising a debenture loan.

**THE PROFITS OF RAILWAYS.**—It having been pointed out that the Guaranteed Railways get their supplies from Europe at the rate of 1s. 10d. per rupee, the Government paying the difference between that rate and the 1s. 4d. of the current rate of exchange, and argued that if the Railways had to get their supplies from England without getting sixpence in the rupee from Government, they would work at heavy loss, a Bombay paper shews that this appears to have been under a misapprehension. It is true that for new lines and works made out of capital the conversion of the rupee is still made at the rate of 1s. 10d., which was fixed when the rupee was above that exchange value. But purchases made out of revenue for the working of the lines—consumable stores such as coal, oil, rails for renewal and the like—are paid for at the ordinary rate of exchange. These purchases on revenue account are now by far the largest and most important, the expenditure on capital account in England for the old Railways being inconsiderable.

**CONTEMPORARY OPINION.**—The *Indian Daily News* is not surprised to find in INDIAN ENGINEERING a strong protest against the recommendations of the Finance Committee in respect to the officering of the Public Works Department with Engineers. The professional paper sees, in the proposal to strict recruitment "in the first place to Royal Engineers and to statutory natives on two-thirds pay, not indenting on Cooper's Hill College unless it is found necessary to do so," simply a device to extend and perpetuate an evil system which has already grown to regrettable lengths—namely, the employment of military men, with staff pay in addition to their proper regimental emoluments, on purely civil duty. Our contemporary thinks that there is no need for Royal Engineers in the civil branch of the Public Works Department. Apart from their high pay, they are a most costly agency, as the Peshin Railway sufficiently demonstrated. In the interests of the country, we should welcome a scheme to reduce their numbers in such purely civil departments as irrigation, accounts, &c., in preference to extending them.

**AN IMPORTANT UNDERTAKING AT HONG-KONG.**—The surveys, plans and estimates for the Praya reclamation have been completed by Mr. Stone, and have been placed in the hands of the Government. They are said to be very satisfactory. The cost is estimated at \$3,000,000, for an extension of 250 feet along a shore of 2½ miles. The new



sea wall will begin a little on the further side of the westernmost mala, and will preserve a pretty uniform distance of 250 feet from the present wall, till it reaches the point at the end of Wing Lok Street, at which it will approach the present shore to within 25 feet. It then gradually widens out to the 250 feet breadth till Pedder's Wharf is reached. From Pedder's Wharf to Murray Pier a much wider basin will be filled in, giving a reclamation of about 500 feet width. On this ground fronting the City Hall it is proposed to place the statue of the Queen, subscribed for in commemoration of the Queen's Jubilee. The work of reclamation will occupy about seven years. A detailed survey, however, will have to be made before it can be commenced. It is said that for 250 feet beyond the proposed extension the bottom of the sea runs level, and that a farther extension could be made at a very small cost.

**GREAT WESTERN INDIA RAILWAY.**—The *Pioneer* says:—As one outcome of the offer made to the Government of India by the promoters of the Great Western India Railway it has been determined that the sufficient survey of the Rajputana desert routes, which has been so frequently urged in the *Pioneer*, shall be carried out during next winter. Mr. Horace Bell, C.E., now at home, will be offered charge of the survey, with probably two Executive and two Assistant Engineers on his staff. The Government of Bombay and the Viceroy's Agent in Rajputana will be asked at once to give all possible aid in the way of collecting statistics—an arrangement which will, we trust, ensure the co-operation of Mr. Edward Trevor, Collector of Hyderabad, Sind, whose knowledge of the regions concerned is unique. Not only will the country between Delhi and Karachi proposed to be traversed by the Great Western scheme be examined; but the extension from Johlpore, as well as the Ajmere-Bahawalpore route, and finally the Pachpadra-Omerkote route, which has been so often before the public already. It is understood that the Military Member of Council and the Commander-in-Chief are in entire accord as to the necessity of instituting the above enquiry, in view of the probable military requirements of the future.

**JAIL MANUFACTURES—AGAIN.**—A correspondent, writing to a contemporary, complains that jail manufactures are once more coming to the fore in competition with private enterprise, much to the detriment of the latter. The former, which consist chiefly of the coarser kinds of the textile fabrics, both cotton and woollen, used in former times to be made by the hand-loom in India, and the weavers, as a matter of course, were driven to the wall. Thus was an ancient industry ruined by a doubtful policy of the Government, and but for the fact that the weavers found ready work in the many mills now scattered all over the country, their lot would have been a hard one indeed. In the days of Lord Ripon and Sir Evelyn Baring a fiat went forth for encouraging the efforts of local enterprise. Everything that could be made in India was to be preferred to indenting articles from home. The wisdom of this step could never be doubted, as the goods could not only be procured cheap, but could be had whenever required without waiting for months to be sent out from England. In fact, the order referred to, actually prohibited the competition of jail labor with private works, and in order to remove all chance of such a contingency happening, machinery employed in jails was ordered to be sold, so that the convicts may be employed in manufacturing with their own hands.

## Current News.

COLONEL CONWAY-GORDON is again suffering from inflammation of the eyes.

THE first instalment of boring machinery for the Madras diamond-fields has arrived at Madras.

THE steam laundry, which was recently purchased in the Straits for Rs. 14,000, has been opened at Rangoon.

THE Bombay Corporation has voted Rs. 67,000 for the purchase of land at Khetwady for a hospital for epidemic diseases.

THERE are, we hear, very favorable reports regarding the discovery of gold in the Raichore District in the Nizam's Dominions.

CALCUTTA has experienced *pucca* monsoon weather during the past week and it is hoped that the seasonal rains have now set in.

AN expenditure of Rs. 7,800 has been sanctioned by the Mysore Government for the construction of a cemetery in the gold-fields of Kolur.

MR. STOREY, the Superintending Engineer for Hyderabad and Secretary to the Resident for the Berars, has assumed charge of his duties.

THE date of the Ball which is to be given by way of housewarming at the new Viceregal Palace, Simla, is definitely fixed for the 8th proximo.

IT has been decided to withdraw No. 4 Company, Bengal Sappers and Miners, from Kaludanda to Roorkee before the commencement of the rainy season.

MAJOR THE HONORABLE M. J. TALBOT, R.E. of the Survey of India Department, has been permitted to revert to the Home Establishment owing to failing health.

ONE of the sections of the Bengal-Nagpur Railway—Raj Nandagaon to Raipore, 42 miles—will shortly be completed, all excepting the bridge over the Seonath.

THE Secretary of State for India has sanctioned an expenditure of Rs. 49,98,810 on the reconstruction of the Nadrai Aqueduct over the Kali Nadi on the Lower Ganges Canal.

WE understand that during the temporary absence of Mr. D. W. Campbell, the Agent of the East Indian Railway Company, Mr. R. C. S. Mackenzie will act as Agent.

THE Syndicate of the Punjab University have sanctioned the proposal to give over charge of the Engineering Class of the Oriental College to the Principal, Mayo School of Art.

A SUM of rupees nineteen thousand has been sanctioned by the Moorshedabad Nizamat authorities for the construction of and repairs to the Nawab's palace and other buildings at Moorshedabad.

SIR E. C. BUCK will shortly proceed to Madras and Bombay to confer with the local Governments on questions affecting the work and future organization of the Agricultural and Survey Departments of those presidencies.

A CROWDED meeting, representative of all classes of the community, has been held at Vizagapatam for the purpose of memorializing the Government on the question of constructing a coast railway connecting Madras with Calcutta.

GOVERNMENT having ruled that the N.-W. R. Director should in future spend three or four months annually on the Sind and frontier sections of the North-Western Railway, Colonel Wallace, with a portion of his office, has moved for the time being to Quetta.

A MEETING of selected members of Council was held at Simla last Saturday to consider Mr. Nobel's proposals in regard to the petroleum investigations in the Punjab. Mr. Nobel wishes to form a restricted Company for the purpose of carrying out the work.

BARODA will, not long hence, have a new market, the total probable expenditure of which will be six lakhs. The design, prepared by Mr. R. F. Chisholm, is receiving favorable consideration by the persons interested in the establishment of a good market in that city.

THE authorities of the East Indian Railway Company have proposed to construct a new station house for the Hooghly station at a cost of about one lakh-and-a-half in connection with the junction with the Jubilee Bridge Branch line with the Naihati station of the Eastern Bengal State Railway.

A GREAT Railway Conference will be held at Simla on the 6th August. Nearly every railway in India will be represented, and the Conference will consider traffic and other questions of a general character. Colonel Conway-Gordon will preside, and Captain Wilson, R. E., will be Secretary.

THE Mysore Public Works Department have been authorized to expend the sum of Rs. 41,650 for improving the Muddur ancient and channel. The Muddur ancient is in the Mandya Taluk. The irrigation is by means of channels supplied from the river Shimsha, and the whole taluk is well supplied with water.



A meeting of the Calcutta Jute Manufacturers' Association, which was held last week, it was decided to continue short-time working for a further period of twelve months, dating from the 15th of February next. The proposal to work only 4½ days per week from the 1st of this month was not adopted.

COLONEL HASTED, Chief Engineer, Madras, has selected four schemes for the water-supply of Bangalore of those submitted. His Highness the Maharaja is to have the benefit of consulting Lord Connemara on this important subject, which so gravely affects the sanitation of the native town and cantonments alike.

THE Railway authorities are making great progress at Quetta and have run a new line of rails in the Cantonment direction to connect with the Commissariat Shed, which, of course, when troops concentrate here in any great numbers, and have to push on to the front, will be the spot where the greatest strain will come.

VERY heavy rain has been falling at Castle Rock and Braganza Ghaut on the W. I. P. Railway. A portion of the line has been washed away, and the rest of the Ghaut line is considered unsafe for traffic. Traffic has been stopped between Castle Rock and Marmagao, and it will take some time before communication is restored.

MR. FURNIVALL, the Agent and Chief Engineer of the N. G. S. Railway, has submitted a proposal to the Board of Directors for erecting new Loco. and Carriage Shops, for the whole line, at Kazipett. This question, the Agent is of opinion, will have to be sooner or later taken up, but not until the Chanda or Raipur extension has been decided on.

It has been ordered by His Excellency the Commander-in-Chief that when artillery practice is carried on in places near buildings or private property, which are likely to be injured by the concussion, due notice shall be given to owners or occupiers, in order that precautionary measures may be taken. As far as practicable, firing from such places should be avoided when the wind is blowing in the direction of buildings likely to be affected.

REGARDING the management of the Koreshi Ferry, it has been arranged that the entire ferry management and levy of tolls be under the Deputy Commissioner, Dera Ghazi Khan, except the construction and maintenance of the bridge of boats, which shall be under the Public Works Department, and the revision of the ferry establishment at Koreshi with effect from 1st January 1888, at a total cost of Rs. 1,872 per annum, will be met from Provincial Funds.

## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

### LUCKNOW BORING.

SIR,—After the enormous expenditure incurred by the Lucknow Municipality in getting out efficient machinery for the artesian well now in the course of progress, and notwithstanding the fact that the work is in charge of an expert from America, I was indeed surprised to hear that the present boring has had to be abandoned on account of it going out of plumb. It is failures of this sort that mislead and make others backward before they lay out money in this kind of undertaking. I have read the interesting pamphlet on "Artesian Boring in the Sunderbunds," by Mr. F. J. Agabeg, which has been published by you, and I should strongly advise the Municipality, before wasting any more public money, by getting out hydraulic machinery, to consult some other expert in the matter. Running sand seems to have been successfully coped with in the Sunderbunds, even without the aid of steam machinery, let alone hydraulic. Hoping, Sir, I will be excused for the few remarks I have made on the subject.

ECONOMY.

### THE PIONEER AND THE PROFESSION IN INDIA.

SIR,—The members of the P. W. D., who entered previous to 1873, must be obliged to the *Pioneer* for the article in the issue of 19th June, which states: "Cooper's Hill was founded to put a stop to the want of education, the bad work, the waste of material and the corruption that reigned in the Public Works Department throughout India. It is conceivable that times have so changed that a competent and honest agency is to be locally obtained through the Indian Engineering Colleges. But there is nothing in the Commission's report to satisfy us that this is so."

Such a gross insult to the Engineer trained in Indian Colleges, and to the whole of the staff, both Civil and Military, who joined previous to the advent of Cooper's Hill, has never previously been written, not even the famous circular of General Strachey's during Lord Mayo's Viceroyalty can beat it.

Even the Government of India are implicated, for they strongly opposed the founding of Cooper's Hill College. It is well known that the College was founded to find a snug berth for a certain gallant officer, who has a very near relative on the staff of the *Pioneer*, which accounts for much. I do not think

that Cooper's Hill men will thank the writer for his ill-advised advocacy.

ONE OF THOSE SLANDERED.

### THE GOVERNMENT OF INDIA P. W. D. RESOLUTION NO. 613G., DATED THE 14TH MARCH 1888.

SIR,—I have read your suggestions in the article in your paper on the above, and think that you deserve thanks for taking up what seems to the ill-used ones a very straightforward case in equity.

You had already in previous issues touched upon the Government Resolution, but the injustice done to C. H. men prior to 1878 was not of course known to you, then, or I think they would have found a champion in you before this. But better late than never, and those concerned should be much obliged to you for bringing public light to bear on the point in question and trying to do them a good turn.

No doubt the Government of India view the matter somewhat in this light. When we, who were appointed before 1878, were in practical course, we were nominally still at College, while those appointed after that year went on to practical training as graded Assistant Engineers. This is really a distinction without any difference. Our practical training was as useful towards making us capable servants of the State, as that of the more recent and fortunate men, who learnt their practical work at the expense of the State, and as Government have allowed some of us to do this, they should in equity allow all. When it is considered that by giving us this concession (if it can be so called) that Government will only add six months to our service, for that was the time we spent in practical training, we might reasonably expect fair treatment.

MENTE MANUQUE.

### UNDER-SECRETARIES, P. W. D.

SIR,—The Under-Secretary to the Government of Bengal in the General Branch of the P. W. D., is an Executive Engineer 4th grade. The Under-Secretary to the Government of the N.-W. P. and Oudh, General Branch, is an Executive Engineer 1st grade and Major R. E. The "Classified List" of the P. W. D. does not, however, give the dates on which these officers took up their respective appointments, and was it not for the aid of the Punjab "Quarterly Civil List," the date on which the Under-Secretary to the Punjab Government assumed charge of his appointment would have been equally mysterious.

The Civil List, however, gives the date on which the present Under-Secretary to the Punjab Government, General Branch, P. W. D., who is an Executive Engineer 1st grade, took charge of his office as the 7th August 1882. That is, in less than two months hence this particular Under-Secretary will have been six years sitting in the broad-bottomed, soft-cushioned, chair in the P. W. D. Secretariat.

Punjab Government's Notification No. 1,355, dated 21st August 1886, written, it is understood, by Sir Charles Aitchison himself, limits the tenure of this appointment to four years. This Notification, by the way, appears to be considered more honored in the breach than in the observance, as it is believed pretty generally that the selection in the first instance was not the happiest that could have been made for the post of Under-Secretary.

The present Chief Engineer and Secretary to the Punjab Government in the P. W. D. must be well aware of the existence of the above Notification, as his own appointment as Chief Engineer, Punjab, dates from December 1885; but, as a matter of course, the present Lieutenant-Governor of the Punjab can hardly be aware of it. The question that naturally suggests itself is, who is responsible for neglecting to place the case before His Honor the Lieutenant-Governor?

In days gone by, it was invariably the custom that once an officer became what was then designated "Assistant Secretary," or Assistant to the Chief Engineer, he never left the Secretariat, except on promotion to Superintending Engineer, and if the antiquated system is permitted again to become the rule, the present incumbent will have become quite rusty in his easy-chair.

The Under-Secretary in the P. W. D. was not the only one mentioned in the Notification previously quoted, although he certainly heads the list of Under-Secretaries specified by Sir Charles Aitchison, which are as follows:—

The Under-Secretary, P. W. D., the Under-Secretary, Civil Department, and the Senior and Junior Secretaries to the Financial Commissioners. "The object being that it is desirable to give a considerable number of officers an opportunity of acquainting themselves with Secretariat duties—an object not likely to be attained so long as the orders of Government are so systematically ignored and set aside, as in the present instance.

SUFFERER.

### MOORE'S IMPROVED CAST-IRON SLEEPER.

SIR,—I see "Rail-roader" has five faults to find with my plate sleepers. I will deal with his criticism in detail.

First as regards the rail resting direct on the iron inducing rapid oxidation. I can assure him that this will not occur. There are many devices that have been used, wood packings, asbestos sheet,







fact, the bearing of which can be but little gauged just now, will be taken up and investigated in particular by specialists.

I shall have enough to do in the attempt to establish the head-fact, for which demonstration the "illuminator" has been designed; it having so far, in my opinion, effected what it was intended for.

When once generally known and established, there will be such a vast amount of direct investigations of a utilitarian nature to be gone through, that scores of specialists will be needed.

Even supposing the head-fact I mean to demonstrate comes to nothing, the improved illuminator, to take one instance out of many, now shows the human blood red corpuscle and the serum in such a very superior way to what was hitherto possible, that by its help the systematic examination of blood in its healthy condition and at several stages of different diseases should not be put off a day later than at all practicable.

There is every reason to believe that the direct influence of medicines on the vitality or welfare of the blood corpuscles will be visible just as well as the supposed changes they do or do not bring about. Was there but a remote hope of that, namely, of checking such influence which hitherto there was but little possibility, since but very little was seen, or at least seen but very imperfectly in blood, now that such very deep insight is possible, the matter should be gone over again.

As nature always proves itself to be most primitive and simple in working out apparently most complex results, the likelihood is that it will turn out, that to keep in good health amounts to securing or restoring those conditions of serum (namely, mechanical or chemical conditions) which facilitate the rearing-up of those swarms of animalcular aggregations of live atoms (which last pervade air, water and food) called red corpuscles of blood: but to do that may not be easy.

The new illuminator having such hopeful prospects, the above being only one out of many, I am not going to let "Microscopist" undermine the foundations intended for such hopeful superstructure by his simply quoting authorities.

Opinions and authorities are of no weight, as opposition concerning the laying of foundations of a new subject. Facts are the only admissible materials. It is quite probable that if those authorities were to consider the present subject, and the objections raised on their behalf, they might have occasion to say "Oh! save me from my friends." I shall therefore follow "Microscopist" in several of his objections, first sub-dividing them into optical, and next biological or others. I need here remark that this last division in my article barely amounted to two per cent. of the whole, but in the notice by "Microscopist" it amounts to fifty per cent. and many issues are raised under that heading. As he gives me some advice, I hope he will take some also as sweetly as I took his. So first let him read over again carefully the original article on the "illuminator," whilst helped with the following:—

*Optical Considerations.*—I did not expect the life or live atoms would be readily detectable, but simply hoped they might be so through the most intense lighting. Who can be sure of success till it be a question of the past? They might have existed and yet not be seen, not being sufficiently large to convey an impression to the retina. But, so far as I am concerned, had they not been seen, the matter would have remained a private speculation not worth committing to writing, much less to printing.

And now shall I ask, Why should not "the great obstacles in the way be got over by mere illumination improvements?" Why should not illumination be all powerful in a question, which from first to last is primarily a conveyance of light from an object to the retina?

Taking the larger diameter of a fine human hair as  $\frac{1}{400}$ th of an inch, and supposing it a full circle of that size, instead of an oval, as the objects to be observed are about  $\frac{1}{40000}$ th, though possibly  $\frac{1}{10000}$ th, part of an inch in diameter, it follows that the end or section of a human hair has a surface 40,000 times as large as the live atoms to be viewed.

If the amount of light that is caught by the very end of that hair be taken as a unit, it again follows that the above objects will be able to catch but  $\frac{1}{40,000}$ th part of that light.

Considering the difficulty there is to see at all, bare eye, a hair's section in the sun's light, the fact that the microscope does not increase light, but on the contrary absorbs or destroys some, and in front of the above very large denominator to the unit of light, can any one come to any other conclusion that illumination is a prime factor of vision in this case.

Indeed (besides the above commonsense and plain way) were it not to avoid over great tediousness in the long and difficult line of answering objections often raised by half a dozen words, I could demonstrate rigorously that illumination of the object is the very factor of vision which primes all others in microscopic observations of very minute objects, say of those that are below  $\frac{1}{25,000}$ th of an inch in diameter.

I certainly am not going to follow Dallinger and Drysdale as suggested, however clever and able they be generally, the moment I see distinctly how in observations of extremely minute objects they are blunting their retina at the very instant that there is most need of the greatest keenness. The President of the Royal Microscopical Society will be liable to have his retina blunted by too much light, as well as the one of the less prominent observers

No wonder that he, the Rev. Dallinger, relatively to bacteria germs to quote his own words of some time back, but when most powerful and improved microscopes were at hand, says "yet they do exist and remain floating long after others are deposited, nor can we detect them with the microscope." Is it because Dallinger could not detect them, that when somebody else says—Owing to some addition to the microscope not only can those germs be seen, but also the very process of evolution through which step by step the

larger germs (say the  $\frac{1}{80,000}$  of an inch) rise towards the formation of bacteria amoeba, living matter, etc., etc., may be observed and easily followed; it is rather to be concluded with "Microscopist," mind well, previously to trying whether such can now be seen or not, this "illuminator" cannot shew all that, the best is to follow in the rear of Dallinger and others.

Does this not amount to saying "no mentionable progress beyond that which has been accomplished by one is to be hoped for from another?" Can "Microscopist" look at his position in this way?

In a second letter I shall answer several other objections raised.  
G. DUBERN.

## Literary Notices.

ALGEBRA MADE EASY. By K. P. Basu, M.A. Calcutta. 1888.

THIS book is meant to afford the "F.A." student all the information that he needs for that Examination in the University of Calcutta, of which the author is a distinguished alumnus. Mr. Basu, however, brings the additional advantage of long and varied experience in mathematical tuition in Bengal to bear on his task, and when we add that he is the author of other *Students' Aids* in the same branch of education, it may be inferred that the result is commensurately satisfactory. That this is the fact we are glad to testify, and we can safely say that the book will admirably serve the purposes for which it is intended.

A novelty in the book is the chapter on Permutations and Combinations, which is explanatory to a fault. But as the author is acquainted with the failings of the *Indian* student, he has had, doubtless, good reasons for such fulness of illustration of this by no means simple subject, which so often proves a stumbling block to the beginner.

The other chapters of the book call for no special observation except that they display both care and discrimination in the treatment of their subject-matter.

The examples throughout the book are numerous, and the "hints" interspersed go far to make the judicious selection useful and instructive in a very high degree.

We can strongly recommend the book, and hope that it may find a place in the educational curriculum of Bengal. It can certainly hold its own with some text-books we have seen, and we wish it the success its merits deserve.

## New Books and Reprints.

### TRADE, COMMERCE, MANUFACTURES.

- HARRISON (W. J.) A History of Photography. Written as a Practical Guide and an Introduction to its Latest Developments. With an Appendix by Dr. Maddox on the Discovery of the Gelatino-Bromide Process. 8vo. sd., pp. 144. Lund (Bradford). Trübner ... 3/6
- JONES (Robert H.) Asbestos: Its Production and Use. With some Account of the Asbestos Mines of Canada. Cr. 8vo. sd., pp. 76. Lockwood ... 2/
- MORRIS (D.) The Vegetable Resources of the West Indies: An Address Delivered before the London Chamber of Commerce, 27th March, 1888. Cr. 8vo. sd., pp. 35. Silver ... 6d.
- PARNELL (G. F.) A Superficial Ready Reckoner for Case Makers, Packers, Merchants and Wholesale Warehouses. 3rd ed. 8vo. bd. Kelly ... 10/
- STEVENSON (T.) A Treatise on Alcohol: With Tables of Spirit Gravities. 2nd ed. Fcap. 8vo. Gurney ... 3/6
- SOAPS and Candles, Edit. by James Cameron, (Technological Handbooks.) Post 8vo, pp. 312. Churchill ... 7/
- THOUSAND WAYS (A) To Earn a Living. Fcap. 8vo, pp. vii.—184. Carn and Co ... 1/
- WEBSTER'S Pocket Ready Reckoner; or Commercial Handbook for Finding the Value of any Number or Quantity of any Kind of Merchandise. With Tables of Interest, [Stamp Duties and Wages Calculations. 32mo. Ward and Lock ... 6d



## General Articles.

### HINDU HOSTEL, CALCUTTA.

THE annexed illustration represents the proposed Hostel in Calcutta for Hindu students. It is situated in the midst of the large educational institutions, which lie in the vicinity of College Square, on a site obtained from Government behind the Senate House, and is being built from funds subscribed since Sir Ashley Eden started the movement during his incumbency; these funds are not sufficient to carry out more than a portion of the project, and arrangements were therefore made to build the first story, which it is expected will be ready next month. Meanwhile steps are being taken to obtain further donations, in order to complete all the three stories of the Hostel.

The plan is L-shaped and consists of a range of rooms for students with a verandah corridor running along the south and east sides, i.e., overlooking the courtyard; at the north-west corner is the library and at the south end of the west block are quarters for the Superintendent in charge. For the present it is proposed to place the dining and cook rooms in temporary sheds: the courtyard forms a large play-ground and there is a corner suitable for a gymnasium. Raja Peary Mohun Mookerjee is the President and Babu Radhika Prasanna Mookerjee (Deputy Inspector of Schools) and Pundit Homesh C. Nyaratna (Principal Sanskrit College), Honorary Secretaries to the Hostel Building Committee. Messrs. Bestic and Gwyther, of the P. W. D., who prepared the scheme, are the advising Engineers, and Rai Khetter Chunder Bannerjee, Bahadur, is the contractor for the work.

The illustration we give of the north elevation shews a novel attempt to intermingle oriental details with the modern European system of building; i.e., while employing the simple and useful form of building best adapted for the purpose, the exterior bears the impression of a place built for the sole use of Hindu students. The arch details were designed by Mr. W. B. Gwyther, A.R.I.B.A.

While viewing this subject, it may be interesting to observe that this Hostel forms an important step in the educational facilities offered to students from the Mofussil, and is conveniently situated for the Hare and Hindu Schools, Presidency College, Medical College and several private institutions; and that, if properly managed, there is no reason whatever why the Hostel system should not be a complete success.

The Mahomedan community, who are now fully appreciating the advantages of education and are up and doing, should not be slow in following the example thus set by erecting a similar establishment characteristic of its being intended for Mahomedan students. A convenient site stands due south of the Hindu Hostel; and, no doubt, if this community would take early steps to collect funds, the sympathy and support hinted at by the Lieutenant-Governor, on the occasion of laying the foundation stone of the Hindu Hostel, would be found as freely and ungrudgingly given as in the case of the other institution. Considering that the Hostel system is intended primarily for students from the country, there is no excuse for wealthy Mahomedans standing aloof because the building would be located in Calcutta.

THE INSTITUTE OF CIVIL ENGINEERS.—In the report of the Council for the year 1887-88 submitted at the recent annual general meeting of the Institute members, it was stated that during the past year there were 41 members, 297 associate members, and 196 students had been elected, and 198 students had been admitted. There were now on the books 5,539 of all classes. The receipts amounted to £29,738 12s. 5d., while the disbursements were £14,432 17s. 9d., more than one moiety of which had been devoted to the publications. The nominal value of the investments was £30,000, besides the freeholds of the Institute buildings, which had cost £20,000, the Whitworth Laboratory of £2,000, and trust funds investments £4,624 13s. 10d., aggregating £51,624 13s. 10d.

## PROPERTIES OF FLUIDS.

By A. EWBANK.

### XVII.

(Concluded.)

WE have said that under the influence of the wind force the ship, even if her deck is level, tends to dip or turn over bow downwards. If we take at random any body which can float in water, and if we place it in water in any position, selected at random, we shall generally see it turn over somewhat and select some other position for the position of equilibrium. Let us however take a body which is a perfect sphere of cork or any light homogeneous substance. This body placed in the water in any position will accept that position, merely perhaps rising or sinking a little as the case may be. At one point of the surface we may imagine a north pole marked. At the opposite point of the spherical surface we may imagine a south pole. Between these we may have an equator drawn on the body. Then the body will float at rest with the north pole upwards or the south pole upwards, as both poles may be in the surface of the water and the equator consequently half immersed.

If this body is acted on by a horizontal wind blowing to the north, the body will move in a north direction. But the bows of this vessel—i.e., the front part, will begin to dip. The stern of the vessel will rise. When the bows have sunk somewhat in the water the water will have no tendency to restore the sphere to its original position of floating. The wind still blowing on the new exposed surface the globe will again dip and so on. Thus instead of slipping or sliding through the water as does an ordinary ship, this sphere will roll through the water, performing one complete revolution after another. This process is what the ordinary vessel commences to do. This process the water begins to check and finally completely arrests.

In the case of the real ship, whose deck is on a slope sideways, the wind force turns the ship, if the rudder is not used, from the north direction to some other direction, say N. N. W. To this turning the water opposes no resistance. For the ship is as ready to float with its head N. N. W. as to float with its head due north. Here therefore the rudder is actually required. In the pitching or vertical movement case the rudder is not required, and it could not act. In the horizontal turning or the veering-round case the rudder is required, and it can act. But the tendency of the ship to rotatory movement is in both cases due to the same mechanical principle. In one case the water supplies a counteracting force, in the other it does not.

Thus the ship moving directly before a wind which blows to the north—a wind which in English is called a south wind—and having her deck either permanently or temporarily on a slope, has a permanent or temporary tendency to leave the due north direction. Accordingly the man at the helm is on the watch for this possible deviation. For the sea is seldom smooth and the ship has usually some tendency to roll.

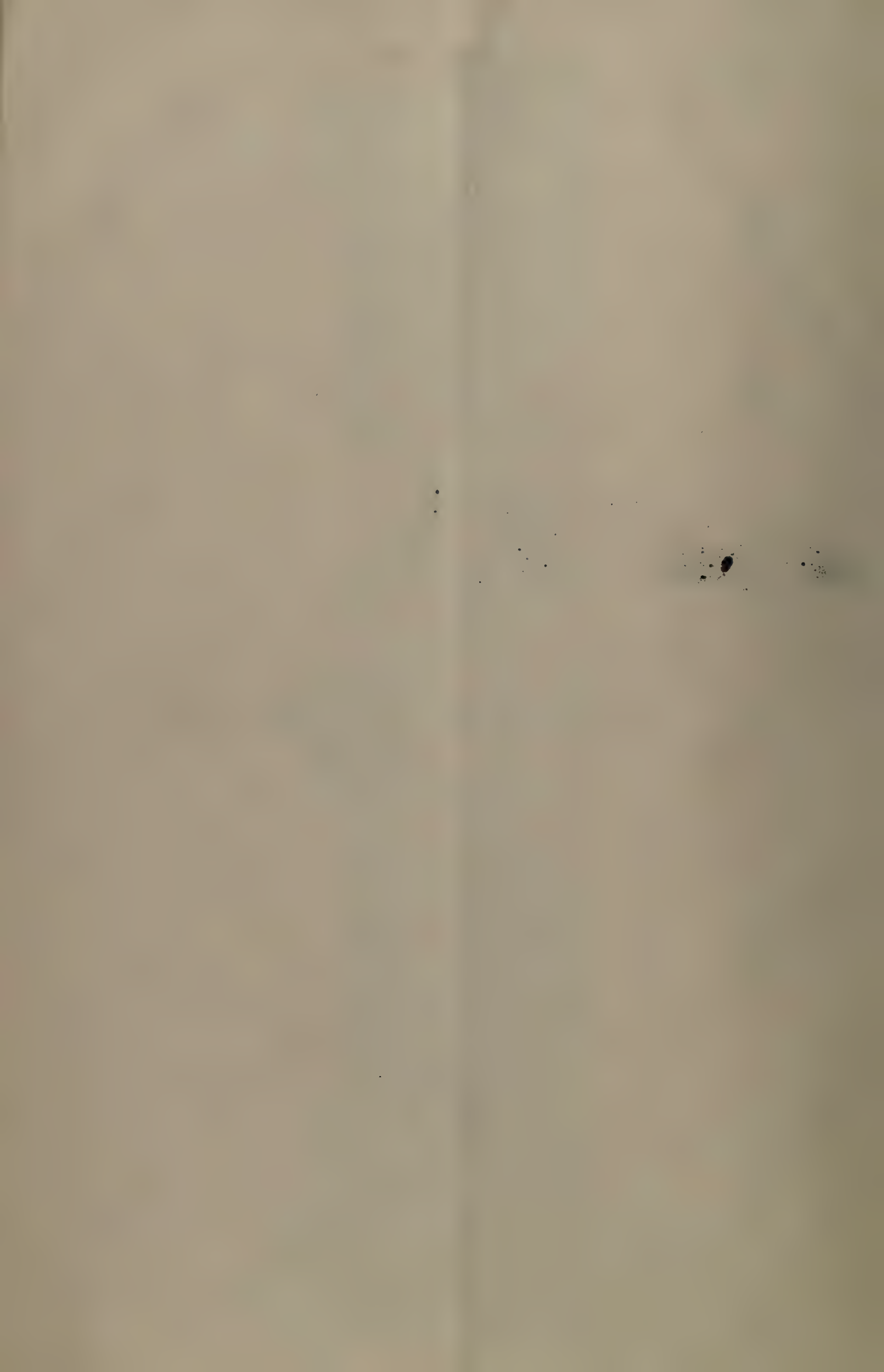
The popular idea of a rudder is, that it is employed to change the course of a ship, and that at other times, viz., mostly, it lies idle. The practical or theoretical—idea of the rudder is, that it is an instrument incessantly used to prevent a ship from changing her course. It is only occasionally used to make a ship change her course.

We have seen that even when a ship is running, as the phrase is, directly before the wind, we may need the aid of the rudder to make the ship keep her course. Generally, a ship is not running directly before the wind. Generally the wind blows one way. The sails are set to get most force from the wind, and this wind force acts in another way. Thirdly, the ship, by her want of sphericity by her elongated shape, moves in a third way. Fourthly, the sea may have currents or



W. B. Randolph  
May 1887







waves that set in a fourth way. Under the influence of wind, wave and imperfect storing of cargo, or an imperfect construction of the ship itself, the ship pitches or rolls, or pitches and rolls together. The wind strikes the sails in gusts, and these gusts vary not only in magnitude, but in direction. As the ship ploughs her way through the water, huge waves may strike her first on one side and then on the other.

Whenever the final resultant of wind pressures and water pressures acts—not through the centre of the ship—but acts right or left of this centre, the ship immediately betrays an inclination to turn. The man at the helm, with a compass placed just before him, is ever on the watch to correct—to destroy—this turning tendency. Thus the rudder seldom lies idle, that is, it seldom keeps its midway position. Usually it is deflected to one side, and there it opposes a resistance to the waters that otherwise would more freely rush past it.

The rudder being thus an intentional obstruction to the waves, there is no object in making the stern of a ship as pointed as the bow. Accordingly for reasons of general convenience it is kept less tapering than the bow end.

In this series of papers, which we have described as dealing with the "Properties of Fluids," the student will find a simple introduction to more elaborate treatises. We might have described these papers as a second series on the "Principles of Mechanics." Our liquids or fluids are bodies that exercise forces and induce movements in other bodies. It is chiefly in this aspect that fluids have been considered.

There has lately been some discussion respecting the advisability of introducing elementary science into the curriculum for the Calcutta University Entrance Examination. Admitting the propriety of introducing some science, it has been asked whether chemistry or physics would be the more suitable. To those who, like the present writer, maintain that physics should be chosen, it has been replied that physical science apparatus is more elaborate and more costly than chemical apparatus. Of this statement the former papers on the "Principles of Mechanics" and the present papers on the "Properties of Fluids" furnish an effective disproof.

We have seen how important principles can be established with the aid of the simplest apparatus. A lad is much more impressed with scientific truths when he sees them exemplified in rough apparatus constructed out of ordinary household articles, than if he is supplied with some elaborate machine expressly made to illustrate the law in question. In the latter case he is apt to imagine that it is a part of the peculiarity of the machine to act as it does. But what we wish the student to do is to forget the particular machine and remember the general law.

These two series of papers on "Mechanics" and "Fluids" do in fact approximately constitute a suitable scientific course for the Matriculation Examination. If they were rewritten expressly for the requirements of our Indian students, a discussion of the lever would be added to the former series of papers; and in the latter series the discussion of the movements of a ship would be considerably shortened.

ELECTRIC lighting aid is helping materially to develop the utility of the Suez Canal. While in 1883 the average duration of the passage through the Canal was 48 hours 30 minutes, it has now been reduced to 34 hours. Indeed, certain selected vessels, amounting to 393, each completed the passage last year in 20½ hours.

THE Russians have made considerable improvements in the harbour at Batoum since the place fell into their hands, and the works will be completed, it is said, by the beginning of next year. The deepening of the basin is already almost finished, the outer wall of the mole is quite finished, and there is but little more to be done to its inner wall. The mole will extend into the sea to a distance of over 850 yards.

## AN IMPROVED CAST-IRON SLEEPER.

By C. E. MOORE, M. INST. C.E.,

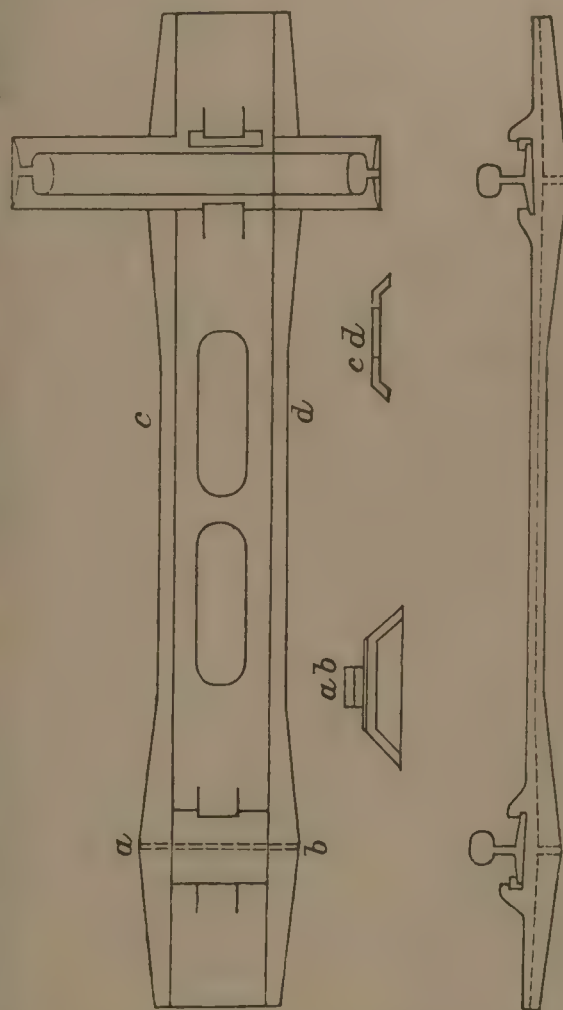
*Deputy Consulting Engineer to the Government of India for Guaranteed Railways, Calcutta.*

THE accuracy of the gauge depends on the accuracy of the casting, but in case of a large number being manufactured, it would not add much to the cost to have them gauged in a machine and planed if necessary.

Flat plate sleepers have, I understand, been tried and found wanting.

They appear to have broken across parallel to the rail and under the rail, so that the fracture was hidden, which made them more dangerous.

Mine would, I think, be an economical sleeper to Railways that could cast them in their own shops, from their own scrap, or near any large foundry, such as Burrakur, and the small number of parts is a great commendation, especially from a maintenance as well as a storekeeper's point of view.



The above sketch shews my design for a cast-iron sleeper, suitable for narrow gauge Railways with a flat-footed rail.

In the only pattern of this sort that I have ever seen, the number of small parts I know were numerous, but of the nature of the fastenings of which I am not sure about.

Above is about the same weight as the other, viz., one maund; but it has the advantage of having only two small keys in addition to the main casting. The shallow trough form is a very strong one, and the sides being joined by a rib directly under the rail, gives great strength with little expenditure of metal.

The spaces cut out from the centre length, not only save metal, but prevent the packing of the sleeper when not required.

G. E. M.



## NOTE ON THE MASONRY BRICK PEST.

BY JAS. CLEGHORN.

*Executive Engineer, P. W. D., Irrigation, Bengal.*

THE specimen brick illustrated was removed from Bridge No. 1, a new work hardly a year old, of the Downstream Road in the Island of Dakshinshabazpore, District Bakergunge. All the face bricks of the masonry of this bridge, between high and low water mark, have been attacked in the manner shewn by the specimen, but the masonry above high and below low water levels appears to have escaped the ravages of this bivalve mollusk pest.

The specimen brick outwardly shews forty-five small perforated holes in its face, the perforations being about  $\frac{1}{4}$ th of an inch in diameter, but if the inside of the brick is examined, it will be seen that these small perforations lead to chambers about  $1\frac{1}{2}$  inch deep by  $\frac{1}{2}$  inch in diameter. These chambers are generally bored in a direction at right angles to the face of the brick, and correspond in size to that of the animals inhabiting them. The growth of the animal appears to be from the extremity remote from the face of the brick, the shell in this part having a permanent gouge shaped opening, the edges of which are serrated, enabling the animal, by a revolving motion, to scoop away space enough in the brick to suit its increasing size. The animal, life size, is shewn in the plate in three different positions.

The actual damage to this masonry work in one year, is that all parts of the work between high and low water marks have been destroyed to a depth of  $1\frac{1}{2}$  inch from the exposed faces; so if this rate of destruction continues which will probably happen, unless the animals are endowed with intelligence enough not to proceed further with their work than is necessary for their own safety, the Bridge must be destroyed in a very short space of time.

Insects have been known to attack iron rails, but the boring is done with the help of a fluid secreted, which acts as a solvent on the iron; the same may be surmised regarding borers which cause damage to limestone rocks and hard wood, but I believe that this is the first case on record where it is shewn that well burnt bricks have been attacked, even the vitrified or over burnt portions not escaping.

No remedy can be produced unless the natural history of the animal is first studied, but a clue is given whereby a remedy may be suggested, as only that portion of the masonry between high and low water marks is attacked, it shews the animal to be amphibious, so a certain amount of air is necessary for its existence, therefore if hollow bricks, capable of containing water, were used in the face portions of the masonry liable to be attacked, these pests might be drowned out. Two or three small perforations in suitable positions, leading to the hollow chamber contained in the brick, would ensure the hollow being filled at every tide, and the retention of this water on the fall of the tide would no doubt cause some amount of discomfort, by the alteration of conditions to any animal seeking a lodgement. The sketches in plate shew the description of brick proposed.

Mr. Wood-Mason, Superintendent of the Indian Museum, has kindly made the following interesting note on this subject:—

"The animals which have bored into the brick are bivalve mollusks of the family *Pholadidae*, sub-family *Pholadina*, genus *Mirphala* probably. The other family of the *Pholadina* being the *Teredina* ship-worms.

The *Pholudine* burrow into clay, sand, wood, brick and rock. They often prove very destructive to breakwaters, piers, piles, sea walls, and other subaqueous structures (*Pholadina*), and to ships and boats and other wooden structures (*Teredina*)."

JAS. C.

## BETWA CANAL, NORTH-WEST PROVINCES.

## IV.

## CONSTRUCTION AND RESULTS.

IN September 1881 the Secretary of State sanctioned the Betwa Canal at a total estimated cost of Rs. 39,82,221, of which Rs. 30,13,485 is estimated as direct outlay and the balance as indirect and interest charges.

When Colonel T. G. Forbes started the head works the rocky loam at the Pareecha site was found to be quite unsuitable as a foundation, and he reported in March 1882:—

Now that preparations have been made for an actual commencement of the work, and a minute inspection and detailed surveys of the site have been made, it is found that the description given regarding the rock being free from cracks and fissures, and thus forming an "excellent foundation" for the weir does not correspond with existing facts.

For a distance of 800 feet on the left flank of the Pareecha site, the barrier is not composed of a "homogenous rock without fissures." On the contrary it consists of weathered and greatly decomposed quartz blocks and moorum, and is in fact an outcrop of the quartz ridge which is met with on the Kalpee road at Gulara, about two miles from Pareecha.

The trial pits which were down to a depth of 8 to 10 feet below W. S. L. shewed unmistakeably the utterly rotten state of the rock, which apparently got worse the lower it was dug into. When pieces were broken off, they could be crumbled between the fingers; and it was seen that the rock was besides full of fissures at all angles, and many nearly vertical.

The weir sluices having to be built on this flank, it was evident that the sanctioned design would have to be materially altered if this site was to be retained. The cost therefore would be greatly increased, as, in addition to the greater depth of foundations than originally estimated for, a much longer pavement or talus would have to be put in. A rough estimate shewed that a weir at this site would cost nearly 10 lakhs of rupees instead of Rs. 7,83,519 as allowed in the sanctioned estimate. Besides this, it was clear that if the weir was built here there would undoubtedly be very heavy leakage below through the fissures in the rock.

Under these circumstances it became incumbent to reconsider the question of the Khoord site, which is situated about a mile below Pareecha. Khoord was originally chosen as the site for the weir by the late Lieutenant Bagge, R.E. It was finally abandoned on account of the Pareecha weir being supposed to cost about 2 lakhs of rupees less than the one at Khoord, but on this point Mr. Anderson, Superintending Engineer, Works, stated as follows, in his letter No. 796, dated 26th March 1870:—

Thinking that a considerable reduction in cost would be the result of adopting Pareecha, which is above Khoord, as the site for the dam, I prepared the accompanying estimates: my anticipations were not realized.

The following is a comparison of the two works:—

	Length.	Content. C. ft.	Cost. Rs.
Khoord Dam	... 5,500	2,055,860	13,36,720
Pareecha "	... 2,650	1,465,253	11,01,886
	Saving	...	2,34,834

Against this saving of Rs. 2,35,000 must be placed loss of revenue due to the 37 cubic feet per second of supply which is contained between the Pareecha site and Khoord Dam. The revenue from this 37 cubic feet calculated at Rs. 500 per cubic foot represents, at 7.5 per cubic cent., a capital of Rs. 2,60,000.

The advantages of the two sites are pretty fairly balanced; but if the afflux due to each dam is considered, the Khoord site has the preference, for at Pareecha the afflux is 11.23 feet, while at Khoord it is only 6.00 feet.

On carefully going over the ground I came to the

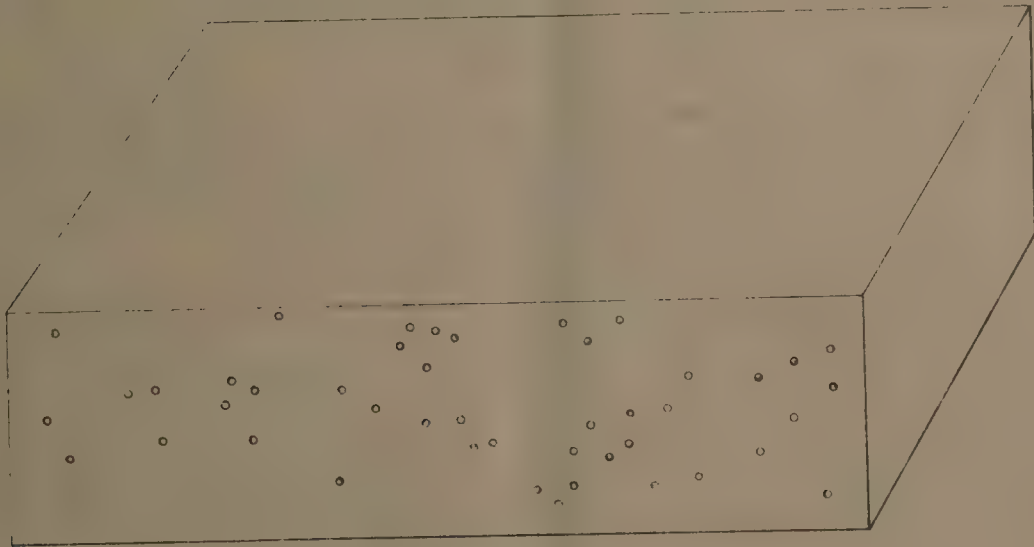


# INDIAN ENGINEERING.

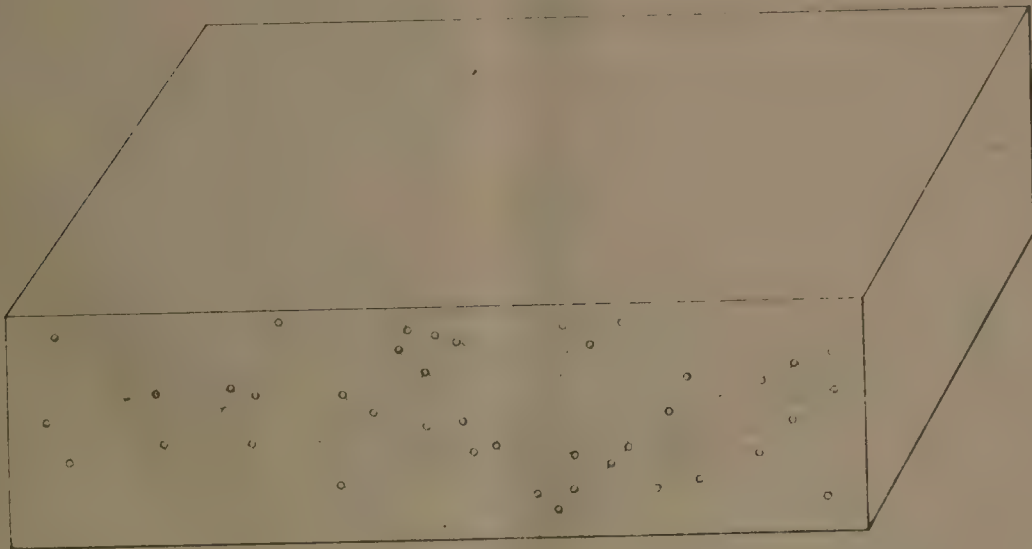
## MASONRY BRICK PEST.



*Life Size*



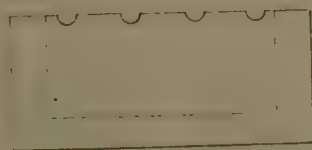
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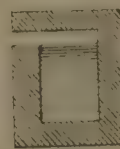
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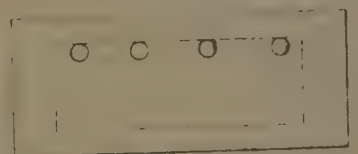
*Section*



*Elevation*



*Section*



*Elevation*

JAS. CLEGHORN,  
EXECUTIVE ENGINEER,  
*Irrigation, Bengal.*







conclusion that in every way was the Khoord site more satisfactory than the one sanctioned at Pareecha. By going a little above the site fixed upon by Lieutenant Bagge, and utilising an island in mid-stream, we find that instead of a weir 5,500 feet in length being required, two weirs, one 800 feet in length across the west channel of the river, and the other 2,650 feet long across the east channel, are necessary; thus giving a total weir length of 3,450 feet only. Good homogenous rock (gneiss) extends across the whole width, and for about half a mile or more down the river. This rock goes well into the right bank, whereas at the Pareecha site a heavy revetment wall is required to guard the right flank. The greater part of the site now chosen across the east channel is itself a natural weir, and little will actually have to be built up in many places, whilst in others the rock will have to be cut down. On the west channel, however, in the deepest part the height of the weir would have to be 41 feet against a maximum at Pareecha of 34 feet. Notwithstanding this, a rough estimate shewed that a weir at Khoord could be built for a little more than 7 lakhs of rupees, or within the sanctioned sum.

The advantages of the Khoord over the Pareecha site may be briefly summed up as follows:—

- 1.—Good rock extending across the whole width of the river.
- 2.—Less expense in building.
- 3.—Less leakage below weir.
- 4.—Less height of afflux.
- 5.—Greater impounding of water, giving an increased discharge in canal of 37 cubic feet per second.
- 6.—Building material actually on site.
- 7.—Site almost entirely in British territory.

Taking the above facts into consideration, I had no hesitation in ordering Major Western to abandon the sanctioned site at Pareecha, and to consider Khoord as the proper position for the weir for the Betwa Canal.

The estimate was exceeded as is usually the case. In his note dated March 1885, the Chief Engineer, Colonel Forbes, gives explanations of excess item by item. Thus:—

Now that the Betwa Canal is approaching completion, it is seen that some items were under-estimated, whilst others were omitted, and although it is possible that all the amounts entered in the enclosed abstract may not be considered absolutely necessary, or at all events may be postponed for a time, yet it is undoubtedly necessary to shew them in an open and clear light.

The grand total of the revised abstract as now submitted is Rs. 47,50,681 against Rs. 39,82,221 as sanctioned by Government of India.

The different items of excess will now be explained.

In September 1883, it was seen that the excess on land was likely to be heavy; the value as entered in original estimate according to Board of Revenue's valuation being only Rs. 12 per acre, whereas the rate actually paid is about Rs. 35 in British territory, and Rs. 80 in Native States and "mauf" lands. The total excess, which is due entirely to the above cause, is Rs. 1,04,173.

Under "Torrent works," a sum of Rs. 24,433 only had been provided; whereas it is necessary to expend Rs. 67,018, or an excess of Rs. 42,585. In the first six miles of canal which crosses a large amount of drainage, only two petty inlets costing Rs. 1,248 each had been provided.

This amount was totally inadequate, for although it was said in Mr. Hair's estimate of 1874 that it was "easy to divert the drainage of the upper part into the Pahooj," yet inadvertently the cost of this diversion was not entered. This has caused an increase of Rs. 16,265 on the main canal. The experience of last rains has shewn that a further expenditure of Rs. 5,000 will have to be incurred on the diversion of minor drainages. On the Hamirpur branch two more syphons costing in the aggregate Rs. 7,000 are required; and minor drainage lines costing Rs. 5,000. On the Katound branch, no provision had been made, whereas three syphons costing Rs. 4,320 are necessary,

and cuts for minor drainage costing Rs. 5,000 will be required.

The line actually taken for the Betwa Canal is much more on the watershed than that originally projected; which if adhered to in points would have landed us in greater difficulties regarding drainage, besides losing command of the country which is now everywhere attained.

Escapes were very much under-estimated. Mr. Hair simply proposed to provide the cost from distributaries, as the "escape would be very simple and short, as the canal passes close to a number of nalas."

The Chief Engineer, Colonel Greathed, however, said this proposition was inadmissible, and allowed a lump sum of Rs. 40,000 on this account, or allowing four escapes at Rs. 10,000; the idea being that it was quite sufficient to turn the escape water into a nala; and it being taken for granted that all nalas in Bundelkhund were rock, it was apparently not deemed necessary to take any precautions for the cutting back of these nalas. These nalas, however, are not rock, and it is necessary to protect them.

In addition to this no provision whatever was made for an escape from the main canal to meet the possible (and probable) case of a flood suddenly entering the canal, owing to the difficulty and delay in closing the head-gates with the enormous pressure under which they will have to work during the rains. To make a proper escape, with full controlling power, would add nearly two lakhs of rupees to present estimate. It would, in my opinion, have been very desirable to make this escape; but taking into consideration the expense, and the fact that in the original estimate approved of by the Local Government and the Government of India, it was evidently thought that this escape was not required, the cost of it has not been entered in present estimate. About 18 miles below canal regulating head (which has three sets of gates) the banks have been lowered to within two feet of high water level, so that in case of a flood down the canal, the extra water may flow off towards the Pahooj river. A few miles lower down the canal, escapes capable of carrying off 2,000 cubic feet per second have been made.

E. A. S.

(To be continued.)

#### NOTES FROM HOME.

(From our own Correspondent.)

AMONG the honors conferred on the occasion of Her Majesty's birthday is a knighthood granted to Mr. George Barclay Bruce, the present President of the Institution of Civil Engineers.

A large portion of space in *Railway Engineer* of this month is taken up by Mr. Walton's paper on Railways for rural and undeveloped districts, to which I briefly referred in a previous letter. There is, among other interesting matter, a contribution from Mr. Langley on examples of permanent-way and points and crossings adopted on the Midland Railway. In these is seen a most interesting method of working and boltlocking points and switches by one lever invented by Mr. Langley.

The French Senate Committee on the Panama Canal Lottery Loan Bill has decided, by a majority of 7 to 2, to recommend the adoption of the Bill. The Company has completed preparations for issuing 360 millions, or half the amount of the loan as soon as the authorization is given. Money is urgently required to carry on the works, and the Company has just borrowed 30 millions of francs from a syndicate of Paris Bankers on the security of the Panama Railway, which belongs to it.

It appears that a very important scheme of Railway extension is in course of preparation, and will be deposited next session for authorizing an independent Railway from the Welsh coal-fields with running powers through the Severn Tunnel and along the channel frontage. From Bristol to London the line will take somewhat the course which was projected in 1883 in connection with the London and South-Western Railway. It is stated that the scheme is under the guidance of a combination of well-known capitalists and influential Railway experts, who may be trusted to push the matter to a successful issue.



A Danish Engineer, Herr Gloesner, with whom is a strong financial syndicate, chiefly consisting of English and French financiers, has obtained a concession from the Danish Government for the construction of a canal across Denmark from the North Sea to the Baltic. It is to cost two millions sterling, and the whole work is to be finished in five years.

A company has just been formed for taking over Mr. Thwaites' patents for generating water gas and other descriptions of gaseous fuel for gas motors, gas furnaces and for heating purposes generally, and for the application of Mr. Thwaites' patents for heating and lighting with liquid hydrocarbons. The company is to establish a fuel testing laboratory and act as guarantors against smoke nuisance fires. It seems therefore that the objects of the company in effecting fuel economy and preventing smoke are likely to be a public advantage.

An interesting account appears in the last issue of the *Marine Engineer* of the auxiliary machinery of the war-ships of the present day. A modern war-ship may well be described as a huge box of machinery—and after describing the several engines for the many duties now required in these ships the account goes on to say: "There are sometimes small engines fitted for other purposes, such as raising and lowering the funnels, &c., but those already enumerated bring the number of separate engines in the Chief Engineer's charge to about 90, or reckoning separate cylinders as engines to somewhere about 150."

M. Jovis, the well known aeronaut, is preparing an Atlantic air-ship, with which he hopes to cross from New York to some point in Northern Europe during the autumn. The balloon in question, which will be called the Atlantic, will be about 200 feet in height and has a cubic measurement of about 25,000 cubic meters. It will only weigh about 4,500 pounds, and with the car, rigging, passengers and apparatus about double that amount. M. Jovis, who will be accompanied by five other passengers, hopes to make 70 miles an hour. The duration of the journey may be about 3½ days and the experiment is estimated to cost £8,000.

The steamship *Arcadia*, now lying in the Albert Docks, with the exception of the *Great Eastern*, is the largest vessel that has ever entered the River Thames. She is about 6,500 tons register, and has engines of 7,000 H. P., which drove her from Belfast at the rate at times of 17½ knots an hour. She is one of the subsidised armed cruisers and will be employed by the P. and O. Company on their Australian mail and passenger service.

Mr. Stockhardt, of Leipzig, has recently patented a process of treating ordinary soft wood so as to be fit to replace lignum vite in the stern tubes of steam vessels and for other bearings exposed to considerable pressure where lignum vite has been hitherto almost exclusively used. The soft wood in question is first impregnated with oil, after which it is subjected to great pressure, causing a considerable increase in the density of the material. Thus prepared the artificial is said to have all the properties of good lignum vite.

## BURMA.

(From our own Correspondent.)

Owing to the rumoured rival competition, and the preparations being made by a certain syndicate at Home, supported by the recent advent in our midst of several gentlemen, deputed to report on the advisability of starting an opposition fleet of steamers in this Province, the Irrawaddy Flotilla Company's workshops are incessantly busy in building a number of steamers and flats; and the pressure in their local workshops has been so great, that several steamers have been ordered direct from Messrs. Denny Brothers, Glasgow. The last arrival, the S.S. *Pugos*, which sailed direct from Glasgow to this Port, has been refitted here, and has just made her maiden trip successfully to and fro Mandalay. Three other boats, the S.S. *Chuan Nyuten* and the *New Dufferin* are being rapidly completed at Home, and expected very shortly. The feeling of keeping the entire water traffic in their hands, is so great under the present management, that rather than allowing holders for the Government steamer, which was offered for sale, for fear that in other hands it may be utilised for the river trade, the Company purchased the steamer taken from the King of Burma for Rs. 25,000 and dismantled the vessel, and use the hull for a floating pontoon. The S.S. *Sir William Peel*, which is now offered to the Company for a similar amount, will also suffer the same fate.

The Company now possess 75 steamers and 105 flats; with this strong fleet, the number in course of building, and the enormous amount of capital in reserve, and considering that a large share of the inland traffic will be taken away as soon as the Toungoo-Mandalay Railway is opened, we think it too late for any rival company to compete for the navigation of the waters of this Province.

One of the latest improved fire engines has been recently imported by the Flotilla Company for the protection of their large workshops and store-yards.

Progress in extending the Poozoundoung Canal has been greatly impeded by the rains. This important scheme was begun by the Municipality in conjunction with the Port Commissioners, with a twofold object of reclaiming and draining the low-lying lands in the neighbourhood of the canal, and of opening out a new channel from the river to the Poozoundoung Creek. By this means would be cut short, a long and tedious journey, always attended with danger at high tides, for country boats proceeding to and fro from the interior. The cutting is now 1,200 feet long by 100 feet wide.

Another gentleman (Dr. Noetling) has been deputed to this Province to report on the mineral resources of Upper Burma. This makes the fifth officer who has been sent over here on the same errand, and it would appear that the Government were dissatisfied with the reports drawn out by the Doctor's predecessors; however, we shall await the present official's report, before commenting on such expensive undertakings. While on this subject we may note that the claim made by Messrs. Streeter, Jr., for £10,000 for preliminary expenses incurred by them in connection with the lease of the Ruby Mines has so far exonerated the local Government of all blame, as all matters concerning the concession were settled direct with the officials of the Government of India. We now hear that a syndicate, through their local agents, Messrs. Gladstone, Wyllie and Company, were also in the field, but unfortunately not accorded that favor which was bestowed on Captain Patton, the Agent of Messrs. Streeter, Jr., and through which bungle the present enquiries are being made in Parliament. We have good grounds for stating, that should the lease be thrown to open competition, Government would certainly benefit by such a measure.

The Government has now in the Press the results of the labors of the Government Archaeologist both in Upper and Lower Burma; a valuable collection of inscriptions of important historical interest were found in Sagaing, Ava, Amarapura and Mandalay, and a tabular list of antiquarian remains is also appended. The book will be illustrated throughout with plans of the different pagodas and their sacred deposits.

## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

Mysore, June 23, 1888.

Mr. C. A. Mahadevasastri, B.A., B.C.E., Assistant Engineer, Hassan Division, is granted privilege leave for three weeks, in extension of that sanctioned in Notification dated 17th May last.

Burma, June 23, 1888.

Upper Burma.

The privilege leave granted to Mr. C. A. B. Target, Executive Engineer, 1st grade, Kyaukse Division, in *Burma Gazette*, Public Works Department Notification, dated the 23rd May 1888, is hereby cancelled.

Lower Burma.

The services of Mr. H. Kench, Executive Engineer, 4th grade, temporary rank, Ruby Mines Division, are placed at the disposal of the Superintending Engineer, 2nd Circle, for employment as his personal Assistant.

Burma special privilege leave for three months is granted to Lieutenant W. R. Morton, R.E., Assistant Engineer, 1st grade, from date of departure from Calcutta to date of arrival at the same place.

With reference to Notification dated the 3rd May 1888, the services of Mr. G. T. St. A. Nixon, Assistant Engineer, 1st grade, are replaced at the disposal of the Engineer-in-Chief and Manager, Burma State Railway, with effect from this date.

Mr. P. E. Raven, Assistant Engineer, 1st grade, is transferred from the Pegu to the Rangoon Division, which he joined on the forenoon of the 14th instant.

Mr. H. Luckstedt, Executive Engineer, 3rd grade, Burma State Railway, is granted 12 months' leave on medical certificate, with the usual subsidiary leave, from such date as he may avail himself of the same.

With reference to *Gazette of India*, Public Works Department Notification, dated the 25th May 1888, Mr. H. F. White, M.I.C.E.



Superintending Engineer, Burma reported his arrival at Rangoon on the forenoon of the 17th June 1888.

With reference to *Burma Gazette* Notification, dated the 6th June 1888, Mr. White took over charge of the 1st Circle of Superintendence from Lieutenant-Colonel W. G. Cumming, R.E., Chief Engineer, on the forenoon of the 18th instant.

Mr. J. Donnan, Assistant Engineer 1st grade, Myingyan Division, is granted three months' privilege leave, with effect from the 1st July 1888.

#### Burma State Railway.

Mr. H. Luckstedt, Executive Engineer, 3rd grade, made over, and Mr. A. R. Lilley, Executive Engineer, 3rd grade, received, temporary charge, in addition to his other duties, of the Sittang District, Burma State Railway, on the afternoon of the 18th instant.

Mr. G. T. St. A. Nixon, Assistant Engineer, 1st grade, received temporary charge of the Pyinmana District Burma State Railway, from Mr. H. Luckstedt, Executive Engineer, 3rd grade, on the afternoon of the 18th instant.

#### Madras, June 26, 1888.

Major W. H. Coaker, R.E., Deputy Consulting Engineer for Railways, is appointed Under-Secretary to Government, Public Works Department, Railway Branch, and to officiate as Joint Secretary to Government, Public Works Department, Railway Branch, during the absence of Colonel C. J. Smith, R.E., on privilege leave.

Major Sidney Smith, R.E., Deputy Consulting Engineer for Railways, is appointed to officiate as Under-Secretary to Government, Public Works Department, Railway Branch, *vice* Major Coaker, R.E.

These appointments to have effect from the dates on which Major Coaker assumed charge of the offices of Deputy Consulting Engineer and Officiating Consulting Engineer for Railways respectively.

The following promotions are made :—

Mr. J. W. Martin, from Executive Engineer, 1st grade, sub. *pro tem.*, to Executive Engineer, 1st grade, permanent rank, with effect from 8th June 1888.

Captain C. B. Henderson, R.E., from Executive Engineer, 2nd grade, sub. *pro tem.*, to Executive Engineer, 2nd grade, permanent rank, with effect from 8th June 1888.

Mr. J. S. Wilson, from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, sub. *pro tem.*, with effect from 24th May 1888.

Mr. C. M. Smith, Executive Engineer, 3rd grade, is granted furlough on medical certificate for one year from 23rd June 1888.

#### Bombay, June 28, 1888.

##### Public Works Department.

His Excellency the Governor in Council is pleased to appoint Mr. Keshav Janardan, Sub-Engineer, 3rd grade, to be an Honorary Assistant Engineer, 3rd grade.

#### N.-W. P. and Oudh, June 30, 1888.

##### Building and Roads Branch.

Colonel J. P. Steel, R.E., Chief Engineer and Joint Secretary to Government, Northern-Western Provinces and Oudh, Buildings and Roads Branch, is granted 5 months' special leave from the 3rd July 1888, under the provisions of sections 2, 61, and 63 of the Civil Leave Code.

#### India, June 30, 1888.

With reference to Public Works Department Notification dated the 21st April 1888, Major S. L. Jacob, R.E., while officiating as a Superintending Engineer, will hold the temporary rank of a Superintending Engineer, 3rd class.

Mr. A. Scott, Honorary Assistant Engineer, Central Provinces, temporarily employed in the Simla Imperial Circle, is transferred temporarily to the Punjab. This cancels Public Works Notification dated the 15th May 1888.

Mr. H. C. Barnes, Executive Engineer, 4th grade, sub. *pro tem.*, Bengal, is permitted to retire from the service.

Mr. J. W. Parry, Executive Engineer, 4th grade, temporary rank, State Railways, reverted to his substantive rank of Assistant Engineer, 1st grade, with effect from the 22nd June 1888.

Mr. E. J. Rumsby, Executive Engineer, 3rd grade, Central Provinces, is granted special leave for one year under the terms of Public Works Department Notifications dated the 3rd October 1887, with effect from the 13th April 1888. This cancels Public Works Department Notification dated the 27th April 1888.

##### North-Western Railway.

Mr. C. T. R. Scovell, Assistant Engineer, 2nd grade, passed the colloquial examination in Hindustani, on the 2nd June 1888.

#### Bengal, July 4, 1888.

##### Establishment General.

Mr. P. G. Jacobs, Assistant Engineer, Kalimpong Division, is transferred to the Darjeeling Division.

Rai Khetter Nath Chatterjee Bahadur, Executive Engineer, Burdwan Division, is granted privilege leave for three months, with effect from the date on which he may avail himself of it.

Rai Haran Chunder Banerjee Sahib, Executive Engineer, at present attached to the office of the Superintending Engineer of the Western Circle, is appointed to take charge of the Rurdwan Division, during the absence, on leave, of Rai Khetter Nath Chatterjee Bahadur, or until further orders.

## Indian Engineering Patent Register.

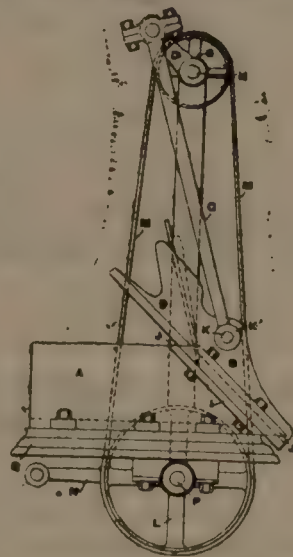
SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 15th June 1888.

- 50 of '87.—Richard Clarkson Scott, of Litherland Park, near Liverpool, in the County of Lancaster, Merchant.—For improvements in, or relating to, effervescing or other beverages formed by dissolving chemical mixtures in water and in such chemical mixtures.
- 120 of '87.—Thomas Henry Noxon, of the Town of Ingersoll, in the County of Oxford, in the Province of Ontario, Canada, Manufacturer of Agricultural Implements.—For improvements in cultivating, seeding and similar machines.
- 68 of '88.—The Writing Telegraph Company (Incorporated) of the City and State of New York, United States of America.—For improvements in autographic telegraphs.
- 80 of '88.—Abraham Colley, of No. 88, Green Street, South Richmond, in the Colony of Victoria, Armorer to the Government of the said Colony.—For an improved cartridge magazine for attachment to certain descriptions of rifles.
- 95 of '88.—Edward John Theodore Digby, of 36, Sinclair Road, Kensington, in the County of Middlesex, England, Gentleman.—For a nutritious and hygienic biscuit for horses and other animals.

#### RECENT BRITISH PATENTS.

MITRE PLANING MACHINE.—G. T. Webster, Drypool, Hull.—The object of this invention is to construct a mitreing machine which shall be simple in its parts. One end of the iron case A is out at an angle of 45°, and two slides J are bolted to it. The plane B works in these slides, and is centrally pivoted by the pin K to the



connecting rod C. The shafts F and H turn in suitable journals which are supported by the frame work, and the band M passes round the wheels G and L. On the wheel L being turned by hand or by power, the band M, wheel G, pin D, and connecting rod C transmit the motion to the plane B. The wood is inserted in the case A, and is pressed against the end I; the incline of the mitre which is obtained is constant. Three claims are made for the inclined end, which is provided with guides, and for the employment of the plane to run in these guides, as described.—No. 793, January 18, 1888.

## ADVERTISEMENTS.

### WANTED.

A GOOD Estimator, Salary Rs. 100, and a good Draftsman, Salary Rs. 60 rising to Rs. 75. Apply with copies of testimonials to—  
H. F. WHITE, M.I.C.E.,  
Superintending Engineer,  
(153) 1ST CIRCLE, RANGOON.

### WANTED.

A COMPETENT SURVEYOR for one year. Salary Rs. 40. Apply to the undersigned, with Copies of Testimonials.  
GEORGE DALE,  
Chairman, Municipal Board,  
MIRZAPUR MUNICIPAL OFFICE, }  
The 21st June 1888. } MIRZAPUR.



## RECORDS OF THE GEOLOGICAL SURVEY OF INDIA.

JUST PUBLISHED

PART 2, VOL. XXI., FOR MAY 1888.

ROYAL 8VO. STITCHED. Price Re. 1.

## CONTENTS:

AWARD OF THE WOLLASTON GOLD MEDAL, GEOLOGICAL SOCIETY OF LONDON, 1888.

*The Dharwar System, the Chief Auriferous rock series in South India, by R. B. FOOTE, F.G.S., Superintendent, Geological Survey of India. —(With map.)*

*Notes on the Igneous Rocks of the districts of Raipur and Balaghat, Central Provinces, by PRAMATHA NATH BOSE, B.Sc., F.G.S., Deputy Superintendent, Geological Survey of India. —(With a plate.)*

*Report on the Sangar Marg and Mehowgala Coal-fields, Kashmir, by TOM. D'LA TOUCHE, B.A., Deputy Superintendent, Geological Survey of India. —(With one plate.)*

The "Records" are issued quarterly, in February, May, August, and November; the annual subscription, including postage, being Rs. 2-8. They contain brief reports and papers; abstracts of more detailed work, notices of the recent discoveries, donations to Museum, and accessions to Library, &c. The following have been published:—

Vol. I., 1868, price Re. 1-8; Vol. II., 1869, to Vol. XX., 1887, Rs. 2 each. Separate Parts, Re. 1 each. (151)

## P. W. D., AKRA DIVISION.

## NOTIFICATION.

Tenders for the supply of coal for Brick burning will be received by the Superintendent, Akra-Factory, up to noon of Monday, the 23rd July 1888.

The probable quantity of coal required is about 500 tons of Rubble and about 15,000 tons of dust coal, and no tender will be considered for the supply of quantities less than one half of the above.

Tenders are to be made in P. W. D. Form No. 14M. and Rs. 200 is to be submitted with each tender as earnest money.

Tenders should specify (1) the rate per ton at which the coal will be delivered into E. I. R. waggons at the Pit mouth or at the nearest Railway siding to the Pit; (2) the rate at which despatches can be made per week after the 1st November; and (3) the name of the Pit from which the coal is arised.

For further particulars apply to the Superintendent, Akra Factory.

S. C. GHOSE, RAI BAHADOOR,

AKRA, )

Superintendent,

The 25th June 1888.) AKRA BRICK FACTORY DN.

## NOTICE.

**TENDERS** for the purchase of the Burma Government S.S. "Palakwa" will be received by the Deputy Director of the Indian Marine up to gunfire of Monday, the 16th July 1888.

2. The Vessel will be sold at Calcutta with engines, boilers, masts, sails, awnings, spars, anchors, cables, boats, and such other stores as may be on board now and which will not be removed previous to the sale.

3. Each tender, before being opened, must be accompanied by a treasury receipt for a sum equal to 25 per cent. of the amount offered, and the balance must be paid within 48 hours of acceptance of the tender and before delivery is taken. The tenders will be submitted to the Government of Burma for orders.

4. The Vessel will be at the risk and charge of the purchaser from the date the acceptance of the tender by Government is communicated to him.

5. The following description of the Vessel is believed to be correct, but any errors or misdescription shall not annul the sale, nor shall any compensation be allowed on that account:—

			Ft.	In.
Length, extreme	...	...	120	0
Between perpendiculars	...	...	116	0
Breadth, extreme	...	...	27	6
" moulded	...	...	16	0
Depth	...	...	6	0
Hull, material built of	...	...	...	Iron.
Where built	...	...	Govt. Dockyard,	Kidderpore,
			...	1882.
When built	...	...	...	1882.
Engines, description of	...	...	Comp. Diagonal non-condensing paddle.	
Where built	...	...	Govt. Dockyard, Kidderpore.	
When "	...	...	1882.	
Cylinders	...	...	20" & 36½"	
Stroke	...	...	30"	
N. H.-P.	...	...	57	
I. H.-P.	...	...	183	
Speed	...	...	10 miles.	
Consumption of Coal	...	...	4cwts. per hour.	
Tonnage, B. O. M.	...	...	144 tons.	

6. The Vessel is open for inspection at the mornings off the Government Dockyard, Kidderpore, on applying for an order to the Deputy Director of Indian Marine.

7. The undersigned does not bind himself to accept the lowest or any tender.

H. M. I. M. DOCKYARD, ) (Sd.) A. GWYN Capt.,  
KIDDERPORE. ) Offg. Dy. Director, Indian Marine.



These wheels are Noiseless and self-lubricating, do not drop oil or allow the rope to be pulled off them, are easily fixed in any position, answer equally well as Vertical or Horizontal wheels, and run perfectly for years without attention.

Sole Agents, SPENCER & Co., Mount Road, Madras.

New and Improved pattern, equally suitable for use in Churches, Hospitals and Public buildings as in Private Houses.



ICE! ICE!! ICE!!!

FOR SALE.

THREE Ammonia Machines, Carrés system, 2 of 1 ton each, 1 of ½ ton capacity with Steam Engine, Boiler and Ammonia Still. The whole for cash. The above are second-hand having been at work 4 or 5 years. For further particulars apply to

P. C. RUBIE,

LUCKNOW ; } P.-ATTY. TO LIQUIDATORS,  
16th June 1888. } General Ice Factory Co, Ltd.  
(141)

WANTED.

AN Overseer for the District Board, Patna, for 18 months certain, @ Rs. 90 per mensem, including allowances.

Applications with copies of Testimonials should reach this office not later than the 15th July 1888. None need apply who has not had experience of road and bridge works, and had not served in the P. W. D. as a 3rd grade overseer for more than five years.

By Order,

POORNA CHUNDR CHATTERJEE,  
ACCOUNTANT,  
For Offg. District Engineer,  
Patna.

(146)

NOTICE.

WANTED, a SECRETARY for the Municipal Board of Sholapur. Candidates are invited to send applications, specifying full Name and Age, to Undersigned, before 20th of July next. Examination Certificates and Testimonials should accompany. Good knowledge of English and Marathi and, if possible, knowledge of Accounts, capacity for active and administrative duties, Professional Engineering, actual experience of Municipal or other administrative work, are the expected qualifications.

The permanent incumbent of the post is on leave without pay, which expires on the 1st of May, 1889, and is at present employed as Secretary to the Surat Municipality, and stands a fair chance of being confirmed there. The Municipality does not hereby bind itself to confer the vacancy upon the best or any of the candidates.

HIRACHUND NEMCHUND, Chairman,

SHOLAPUR MUNICIPAL OFFICE, } Managing Committee,  
21st June 1888. } SHOLAPUR MUNICIPALITY.

WANTED

AN EXPERIENCED ESTIMATOR.

Apply with copies of testimonials and stating salary required, to—

THE STATE ENGINEER,

(143) Bhavnagar.

NOTICE.

TENDERS for the carriage of building materials from Akra to Calcutta, for the year ending 31st August 1889, will be opened by the Superintendent of Works, Calcutta, at his office at 12 noon on Saturday the 7th July.

Form of tender and any further information may be obtained at the Office of Superintendent of Works.

G. F. E. S. NEILL, LIEUT.-COL., M. S. C.,  
Superintendent of Works, Calcutta.

CALCUTTA ; the 20th June 1888.

(145)

P. W. D.  
CHITTAGONG DIVISION.

Tenders are invited for Manufacturing and delivering the materials noted below. The Executive Engineer does not bind himself to accept the lowest or any tender

Name of work.	Tender to be in Form No.	Amount of earnest money to accompany each tender.	Date and hour of opening tenders.	Date of commencement of work.	Date of completion of work.	Deposit-money required to be paid by the successful tenderer.	REMARKS.
Manufacturing and delivering at Nakhally for Civil Buildings, 22 Lacs of Table Moulded and Pugged bricks. 50,000 c. ft. First Class Sorekey. 50,000 " of Brick Material for Concrete.	P. W. D. Form No. 14 M. (Supply of materials)	Vide table on the form quoted above.	* 4th July 1888. (12 noon.)	Half before the 31st March 1889.	(1889) 31st July 1889.	10 per cent. on the total value of the supply.	Particulars and specification can be seen— At the Office of the Executive Engineer 1st Calcutta Division. At the Office of the Executive Engineer Dacca Division. At the Head Office of the Chittagong Division, Chittagong. Samples of materials required can be seen at Chittagong.

\* "The tender will be opened on Monday the 9th July 1888 and not 4th July 1888."

CHITTAGONG ;  
The 1st June 1888,

(138)

F. SILLS, C. E.,  
EXECUTIVE ENGINEER,  
Chittagong Division.



# COMMERCIAL UNION ASSURANCE CO., LD.

*Extracts from the Twenty-sixth Annual Report viz. for the year 1887.*

## FIRE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£769,265 0 0
Interest ...	£ 19,612 0 0
Losses after deducting Re-insurances ...	£443,587 0 0

## LIFE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£125,559 0 0
Interest and Dividends ...	£ 45,649 0 0
Claims less Re-insurances, ...	£ 79,229 0 0

## MARINE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£175,118 0 0
Interest ...	£ 8,294 0 0
Losses after deducting Re-insurances ...	£138,365 0 0
Interest not belonging to above, but included in Profit and Loss ...	£ 13,545 0 0

The Life Fund was increased during the year by £65,648 and now amounts to £1,070,064.

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the un-called Capital of £2,250,000.

The rates of Premium are moderate, but they are not unsafely low, and will be found to stand the test of time, thereby in conjunction with the ample Funds affording absolute security to the assured.

The Total Funds and property in hand on 31st December 1887 stood at £2,613,059.

(39)

C. H. OGBOURNE. *Manager and Underwriter.*

# GEO. GAHAGAN & CO., ENGINEERS, FOUNDERS, AND TIMBER MERCHANTS.

CASTINGS UP TO 30 TONS DAILY. FORCINGS UNDER STEAM HAMMER. RIVETTING BY HYDRAULIC RIVETTER.

*Designs and Estimates furnished for Bridges, Roofs, and all kinds of Iron and Brass work.*

## AGENTS FOR THE FOLLOWING WELL-KNOWN FIRMS:—

Brown and May's Portable Engines, Vertical Engines, and Centrifugal Pumps. The Rhenish Dynamite Company. The United Rhenish Westphalian Gunpowder. Lee and Son's Celebrated Portland Cement J. H. Morgan and Son's Mangalore Tiles.

FOR SALE:—Corrugated Iron, ("Ash and Lacy's" well-known Globe Brand,) Plate, Bar, Angle and Tee Iron, Cast and Wrought Iron Pipes and Fittings, Tools, &c

Glasgow Coats Iron and Steel Company's Steel and Iron Angles and Tees. Flat, Round and Square bars "Coats Best.

No. 1 Dynamite ...	Rs. 1 6 per lb.	No. 1 Blasting Gelatine ...	Rs. 1 12 per lb.
Treble Dynamite Detonators	" 2 10 per 100	Gelatine Detonators	" 2 14 per 100

(44)

BELLASIS ROAD BYCULLA, BOMBAY.

## CREAT WESTERN HOTEL,

(29)

BOMBAY.

MACHINERY  
CYLINDER  
ENGINE

OIL

SPINDLE  
BATCHING  
LUBRICATING

Stocks of all descriptions always in hand. Contracts at reduced rates.

(134)

KER DODS & Co., 81, Clive Street.

## E. T. C. BLEND HIGHLAND WHISKY.

Rs. 25 per dozen.

## GISBORNE & CO.,

(87)

40, STRAND.

## THOMSON & MYLNE'S PATENT SUGARCANE MILLS.

For particulars of Depots, Licensees, &c., address—

THOMSON & MYLNE,

BEHEEA, E. I. RAILWAY;

or 6, Commercial Buildings, Calcutta.

(103)

## A GREAT WANT SUPPLIED.

No Package Genuine  
without this Trade  
Mark.



Registered 14th October 1878.

CYLINDER OIL.

TURNER, MORRISON & Co., Calcutta,

Sole Agents for Bengal.

(92)

No Package Genuine  
without this Trade  
Mark.

## JEYES' SANITARY COMPOUNDS

Thirty-one Prize Medals and First-class Certificates  
Gold Medal, International Exhibition, London, 1885.

Specially Appointed by the Royal Commission for the  
Colonial and Indian Exhibition.

Not a single case of illness occurred amongst the Native  
Artisans employed in the Exhibition owing to their  
Quarters being disinfected by

## JEYES' SANITARY COMPOUNDS.

Supplied in various sized Packages to suit the convenience of Customers.

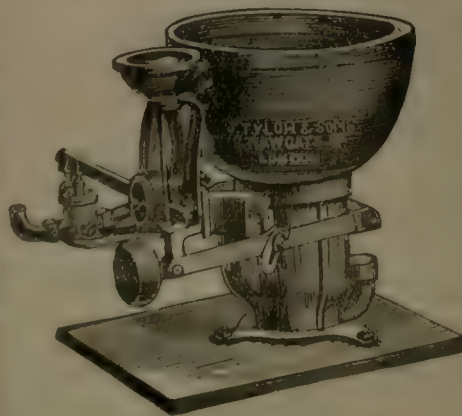
Full Directions for use supplied with every Package.

N.B.—One Gallon of Jeyes' Perfect Purifier Fluid makes one  
Hundred Gallons of Disinfectant.

(142)

DYCE NICOL & CO.,  
SOLE AGENTS, Calcutta.

## Calcutta Plumbing & Gas Fitting Establishment.



Materials of all  
sorts for the  
above always  
in stock. Trade  
supplied on  
the usual  
terms.

J. D. JONES,  
Mechanical Engineer,  
PROPRIETOR.

(108)



## THE GOVERNMENT AND THE PRESS.

(Poona Observer.)

It is lamentable to find that those in high places can descend, at times, to exhibitions of human weaknesses scarcely worthy of them. We have before us particulars of a case, in Calcutta, in which the interests of two newspapers are concerned, but in which the *Supreme* Government have shewn a strange and inexplicable partiality to one. On the 16th of March last Mr. Pat. Doyle, C.E., the proprietor of *INDIAN ENGINEERING*, addressed a letter to Sir Charles Elliot, K.C.S.I., the inciting cause of the communication being the request of Messrs. Newman and Co., forwarded to the Indian P. W. D. Secretariat, for a Government subsidy, in the shape of a large subscription to their Journal, which was a rival organ to *INDIAN ENGINEERING*. Mr. Doyle very properly submitted that since both Journals, *THE INDIAN ENGINEER* and *INDIAN ENGINEERING*, occupied the same field, any aid given to the one, in the manner wanted, must be to the detriment of the other. Messrs. Newman and Co.'s organ, *THE INDIAN ENGINEER*, was started a year before *INDIAN ENGINEERING*; and if it served its purpose, "there would not have been room," so wrote Mr. Doyle, "for another organ of its class like mine." Mr. Pat. Doyle added :—"That Messrs. Newman and Co. did not meet the wants of the Profession in India is best gauged by the position of their organ at present. I am prepared to allow the question of our existence to rest with the Profession whose interest we are supposed to serve. If there is not room for both, it should be the survival of the fittest." In conclusion Mr. Doyle added :—"I would also invite your attention to the fact that while I publish my Journal weekly and issue it at Rs. 12 per annum for 52 numbers, Messrs. Newman and Co.'s only appears fortnightly and the charge is Rs. 20 a year for 26 copies. This difference means a large sacrifice on my part. All I need is "fair play;" and that is my object in troubling you. To enable you to compare both Journals, I beg to hand you copies of the issues of each that have appeared up to date this month." We regret to hear that the Government of India have ignored this representation, and have subsidised Messrs. Newman and Co.'s *THE INDIAN ENGINEER* to the extent of Rs. 4,000, by subscribing for 200 copies. Setting aside the question about this very questionable arrangement being prejudicial to the other organ, there is a very apparent perpetration of "jobbery" which ought to be taken notice of. If justice is not done, the Newspaper Press in India ought to combine and demand their rights. This is a most shameful instance of partiality, and we should not be surprised to hear that some underling has been at the bottom of it. We regret to find that, of late, there has been an inclination, in certain official quarters, to ignore the position which the Press holds as an exponent of public opinion. In the Calcutta case, we should like to know why such official partiality has been shewn. We would advise the proprietor, or proprietors, of *INDIAN ENGINEERING* not to allow a stone to remain unturned in having this gross act of injustice reviewed and rescinded. Nearly ten years ago, Mr. (now Sir) Grant-Duff banned the *Madras Times*, because this journal published one of his minutes before it was officially communicated to the Press. This was both arbitrary and unjust. In the case of the Calcutta Journals the Government of India have acted in a manner that demands explanation. Mr. Pat. Doyle, the proprietor and Editor of *INDIAN ENGINEERING*, is a gentleman well known, not only as a journalist of no ordinary professional ability, but as a mathematician, and an author. Setting personal and professional qualities aside, we think Mr. Pat. Doyle has a clear case against the Government of India; and if he does not obtain redress from that quarter, he must appeal higher. We would give him the address adopted by a petitioner in Madras. Disgusted with appealing to all authorities upon earth, this man at last puzzled the postal people by addressing a letter to "God Almighty; care of Mr. Grant-Duff, Guindy Park." The envelope was duly stamped, but the post office authorities were puzzled about delivering it, and sent it to H. E. the Governor to be forwarded! Mr. Doyle might go higher up than the Government of India. Seriously speaking or writing—the Press of India ought to support *INDIAN ENGINEERING* in the gross injustice done to it. The tendency of officials to ignore the Press, and to act in a high-handed way, as dictated by their own sweet will, ought to have some superior control. What on earth is the use of a free Press, when it is only so in name, and is officially fettered?







## Notices.

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## Obituary.

SPENCER—On 7th July, at Mogul Serai, of cholera, Charles Thomas Spencer, Assistant Engineer, East Indian Railway, aged 32 years.

# INDIAN ENGINEERING.

SATURDAY, JULY 14, 1888.

### THE SIND-PISHIN RAILWAY.

It is curious that the first account of a work in which Indian Engineers (and tax-payers) are so much interested as the Sind-Pishin Railway, should appear in the *London Engineering*; where a series of articles have just appeared, which shews the writer is well acquainted with the subject, though for reasons, which will soon appear, we hope not officially inspired.

These articles give a full and accurate account of the line itself, and, to a certain extent, of its construction so far as the engineering staff only are concerned; but readers who have been accustomed to hear the line spoken of only as a scandal, will doubtless be puzzled whether to believe the *couleur de rose* account given of it in the articles to which we refer, or the general impression. It is a most extraordinary thing they will say, that such a false impression can have been formed of a line which is really a pattern of economy.

Nor will a first perusal clear up matters. For example, the writer speaks in terms of reprobation of "the statements so recklessly made regarding the inexperience of the staff employed on the Railway." Yet Lieutenant Scott Moncrieff, R.E., read a paper before the R. E. Institute, in which he distinctly states that the Engineer-in-Chief was the only directing officer of any Railway experience, and that, with two or three exceptions, all the officers sent up were ignorant of Railway work. This is a good ground for the assertion that the staff were inexperienced, and rumour soon assigned this inexperience as the cause of the supposed extravagance. The probable solution is, that up to a certain point, Lieutenant Scott Moncrieff's account is correct, but that when Government woke to the urgency of the case, they sent up all the men they could muster, most of whom had Railway experience.

So far as the writer goes in enumerating the services of Sir J. Browne, and exonerating him and the staff generally, from the charge of being the cause of the extravagance on the Sind-Pishin Railway, we can agree with him.

But when he further proceeds to state, and adduces figures to prove, that there was *no* extravagance at all, and that the line is one to be proud of, he fairly takes our breath away. There surely must be *some* foundation for the universal belief, among men who ought to know, that there was extravagance amounting to a scandal on the Sind-Pishin Railway.

Indeed, our author himself, repeats that the difficulties and expenses were enormous. In one table he shews that the average daily wage was Re. 1, or quadruple the ordinary average elsewhere, which is an extravagance in itself, as compared with other lines.

He says that the estimate for the permanent Bolan line is Rs. 2,23,754 per mile, against only Rs. 1,96,782 as the actual cost of the Sind-Pishin through a similar country; though the former will be constructed at normal



costs and save enormous charges for animal transport by having a line ready made.

Now this is sheer nonsense. If Sir J. Browne and staff have constructed the Sind-Pishin Railway for Rs. 1,96,782 per mile under such very unfavourable circumstances, what is to prevent Government from employing them to construct the Bolan Railway under more favourable circumstances for, say, Rs. 1,50,000 per mile?

Neglecting, for the present, the minor errors in the article, we will point out at once the principal mistake that the writer has committed, in adding to the 117 miles of mountain line 107 more of mere plate-laying on a level plain, part of which—the Durwaza-Quetta section—*was not even laid by the Sind-Pishin staff*, but by the Bolan staff. He might just as well have added in the Ruk-Sibi line or the whole Indus Valley Railway, and so made out a still better rate.

For the benefit of those of our readers who have not visited that side of India, we will give a detail of the country: The Durwaza-Quetta, Bostan Gulistan, and Killa Abdulla branches, traverse a bare plain, and the former, as noted above, was laid by the Bolan-Railway staff. Also 39 miles of the Sibi-Quetta section is mere plate-laying and was done just at the finish, from the Bolan side. The real Sind-Pishin, so graphically described, and about which there has been so much talk, is 117 miles and may be classed thus:—

Nari-Daliyal	...	30 miles	very heavy.
Daliyal-Nasik	...	27 "	quite ordinary.
Nasik-Sharigh	...	10 "	heavy.
Sharigh-Durgi	...	18 "	ordinary.
Durgi-Manzi	...	5 "	very heavy.
Manzi-Khanai	...	27 "	heavy.
Making a total of:			
Very heavy	...	...	35
Heavy	...	...	37
Ordinary	...	...	45 = 117

Thus, if we wish honestly to compare the Sind-Pishin with the Bolan estimate through a *similar* country, or the Ceylon Railways, we must take the cost of this 117 miles only, and not add branches one-third as costly and then take an average.

To proceed to figures. We first observe an arithmetical error of a lakh of rupees in the deduction for stores transferred to Chummun extension. The deduction of 27 lakhs itself is wrong, at least we can find no trace of it in any published accounts, and we suppose the writer has erroneously deducted the 27 lakhs Kandahar Reserve, which was never debited to the Sind-Pishin Railway.

Nor do the figures given by the author agree with those of the last report of Director-General of Railways, which we shall take by preference as certain to be correct. These give:—

Section.	Miles	Cost. Rs.	Rate. Rs.
Sibi-Quetta	155	4,12,86,969	2,66,368
Bostan-Gulistan	34	40,73,576	1,19,811
Killa Abdulla	8	4,63,170	57,896
Durwaza-Quetta	26	25,25,314	97,127
Total	223	4,83,49,029	2,16,812

There is thus, even without manipulation of averages, a considerable difference from the writer's Rs. 1,96,782.

Nor is this all, for the Director-General's Report only gives expenditure up to end of 1887, whereas, according to the article, Rs. 43,87,000 were still required during 1887 and 1888 to complete the line, which could not all have been spent in 1887. As however we are not, like the writer, engaged in special pleading, but only anxious to get at something like the truth, we will let that pass.

We have then only to deduct from the Sibi-Quetta length, 38 miles of surface line at 1 lakh per mile, which appears to be the average cost of that part of the system, and we get Rs. 37,4,86,969 as the cost of the 117 miles making up the Sind-Pishin Railway.

This gives a rate of Rs. 3,20,401 for an honest comparison with the Rs. 2,23,754 of permanent Bolan line, now that the country is similar, or an excess of Rs. 96,647 per mile; which multiplied by 117 miles gives Rs. 11,3,07,699, quite a respectable sum in these hard times.

The Bolan comparison is not, however, a fair one; the estimate was based on rates inflated by the Sind-Pishin extravagance, and at the rates at which work is even now being done in that part of the country, it could be safely reduced to Rs. 2,00,000 per mile.

We will turn now to another comparison instituted by the writer. The Ceylon Railways. A prudent person before staking the reputation of the Engineer upon such a very rough calculation as the average cost per mile, even if the physical nature of the country be the same, will first enquire into the proportionate cost of such items as are beyond the control of the constructing Engineer, as Preliminary Expenses, Land, Rolling Stock.

In this case we find the proportions to be

	Pre. Ex.	Land	Rolling Stock.	Total.
Sind-Pishin	0.11	0.22	7.7 =	8.03
Ceylon	2.50	4.12	7.86 =	14.48

Eliminate these obscuring items, and we get for the comparative cost of the engineering works Rs. 2,94,769 for Sind-Pishin, and Rs. 2,04,393 for Ceylon Railways.

Further, the latter have much heavier charges for fencing, stations, shops, &c., than have been incurred on the Sind-Pishin.

Altogether, it must be said that the writer of the article, so far from having been successful in his attempt to rehabilitate the Sind-Pishin Railway, has only drawn attention more prominently to the sinful waste that was always known to be going on. A more or less accurate knowledge of the proceedings on that line is too widely spread to be disproved by anything short of an official publication of the *rates of the work actually executed*, which we fancy would be instructive, if not exactly amusing.

The mere fact that the average daily wage was quadrupled, is a proof of extravagance, but it was the fault of the Government, who would not construct the line when they could have done so on easy terms, and consequently had to push it at all hazards.

The worst that can be said of the staff is, that like any other, there were a few incompetent or idle members; and



of the Chief, that he did not attempt to secure economy; remembering always that the frantic appeals of Government to finish the line at any cost, only get it done, did not exactly point in that direction.

Beyond the mere question of a trifle of 140 or 150 lakhs that may have been wasted in details of construction of the Sind-Pishin Railway, there is the much larger one; Who is responsible for the adoption of this route at all?

Our author very truly says, the Engineers were not responsible for the selection of the Hurnai Route, but "Her Majesty's Government, presumably the best judges," and then he falls foul of certain Anglo-Indian papers for grumbling.

We have heard that it was to the ubiquitous Sir Richard Temple, who rode over the ground and declared it specially designed for a Railway by Providence, that we owe the idea of the Hurnai Route, and when we are told that it was decided by "Her Majesty's Government &c.," we ask with Ancient Pistol "Under which king Bezonian?" Because as one Government reverses the actions of its predecessor, it is clearly a matter of chance whether the Government in power at any particular crisis, *did* happen to be the best judge.

We assert that it was a mistake to build the Railway on the Hurnai Route at all, and that it was extravagantly executed, but it appears that the fault does not lie with the Engineers, nor even with the Indian Government, but with the system of party government; about the evil effects of which upon our naval and military administration, there is just now one of the periodical scares at home.

Not being Military Engineers we speak with diffidence, but we should suppose, from looking at the map, that the Bolan was a preferable line of communication with Quetta in a military sense, to the Hurnai, and the recent survey from Kuch to Quetta direct, behind the hills, at the request of the military authorities, looks as if they were not quite pleased with the present line and extra rise of 800 feet. As Civil Engineers we can confidently state, that an extra length of line of 55 miles to be worked over by every train, is a drawback that requires an enormous saving on the capital cost of the longer line to counterbalance it, instead of which we find the longer line has been much the most expensive of the two.

We have now got a line from Sibi to Quetta *via* Hurnai which has cost Rs. 4,62,49,029 deducting for the bit between Quetta and Bostan which comes in for the Chummun extension.

To enable this to be completed, or to get up military stores during its construction, we have a temporary line up the Bolan costing

Sibi-Rindli	16 +	Durwaza-Quetta	25 = 41	Rs.
miles =	...	...	...	41,00,000
Temporary Bolan, 57 miles =	...	...	...	54,00,000
Total				95,00,000

Altogether Rs. 55,7,49,029, plus 55 miles extra mileage and 808 feet ascent on every train, and a possible expendi-

ture of about Rs. 1,30,00,000 more on a permanent line.

Had the line been made up the Bolan in the first instance, we should have had, judging from the figures given in the article—

Sibi-Partun	4	
Durwaza-Quetta	26 = 30 miles @ 1 lakh =	30,00,000
Partun-Durwaza	65 miles @ 2 lakhs =	1,30,00,000
Total		1,60,00,000, only.

And we are asked to rest and be thankful, believing that "Her Majesty's Government are presumably the best judges."

One word more. We cannot as Engineers dislike to see the advance of our Railway system, nor can we blind ourselves to the fact, that either our lines, or the Russian, will advance till they meet. But when these expensive lines are spoken of as insurance against invasion, we think it is at least open to doubt, whether the money would not have been better spent upon men and guns, which are anywhere available against an enemy, rather than upon lines which may assist his advance, or which he might avoid altogether.

We fear that a truly scientific frontier is like a mirage, always on the horizon.

### A SUGGESTION.

#### I.

SUCH information as has reached us regarding the recommendations of the Public Service Commission, shews that it proposes very heavy reductions in the Public Works Department of India—indeed, so urgent does the Commission consider the carrying out of great reductions therein, that it has recommended the discontinuation of the annual supply of recruits to the staff of the Department from the College at Cooper's Hill, till, we suppose, better times.

Paramount Imperial necessities and policy must, it is obvious, override all other considerations. And however much members of the Engineer's profession may dislike it, and however short-sighted the policy of cutting down expenditure on Public Works, which is really not so much expenditure as *investment*, and which in no small degree, by providing honest employment for the able-bodied poor, tends to keep down distress and consequent crime. (We will not say political discontent, for the laboring poor of India have hardly yet reached that point in the march of civilization.) If the reduction be really inevitable, it must be submitted to with as good a grace as is possible under the circumstances.

But it appears to us that sufficient attention has not been given to the possibilities of utilising the existing staff of the Public Works Department, and thus reducing the alleged high percentage which prevails, and, it is said, has for some years prevailed in the P. W. D. in the proportion of cost of supervision to cost of works. With the proposed most extensive reductions of expenditure on



works, either a portion of the staff will need to be provided with inducements to retire, entailing bonuses and pensions, or the already declared abnormal proportion of cost of supervision will become aggravated.

The results of the last attempt at reducing the staff by offer of pensions and bonuses, has not been such as should induce a repetition of the process; it is of course obvious that with the stoppage of the supply of Engineers from Cooper's Hill, and possibly from Indian Colleges, the excessive proportion of charges for supervision to work done will annually diminish, but it would, we conceive, not be inopportune, at least no possible harm can result, if we suggest, that at this moment, facilities exist for the employment of a portion of the staff of Engineers on the Indian Public Works list in work, which they certainly cannot only well perform, but perform better than men who are not Engineers, but from which they have, with a strange perversity, been absolutely excluded.

Of the various minor services where an Engineer might be usefully and appropriately employed, perhaps the Archaeological Department is the one where they could pre-eminently be made most useful. That department is already perhaps fully manned, but it is no secret that the present head of the department, who succeeded, the Royal Engineer officer, General Sir Alexander Cunningham, will soon, on the score of age, be eligible for retirement; while on his present staff, we see but two officers who have, to the knowledge of the public, as yet written any reports at all.

Our attention has been turned to this among other possible openings for usefully employing surplus Engineers of the P. W. D., by the receipt lately of a copy of the report of the Archaeological Surveyor of Bengal. The report is, however, an unpublished one, and the author has evidently presented us with a copy not for purposes of public criticism, though no fair criticism on it could be anything but favorable, from the apparently profound archaeological knowledge displayed therein, but on which we can scarcely pretend to sit in judgment, and the original line of treatment in regard to architectural archaeology, on which we might offer suggestions and favorable criticism. The report, however, is too important as marking a new departure to be kept buried among musty Government records, and we would be glad to see it published with the needful drawings.

The author, as he tells us, is, or was, an Engineer in the Public Works Department, and the report is such as to show that here is an opening for the Civil Engineer and Architect, who has sufficient love for an interesting branch of his profession to forego the steady promotion which a large department offers for the slower promotion in a small department, in addition to learning what, though exceedingly interesting, must be to him a new field of study. That there is reasonable hope of getting men from the P. W. D. willing to undergo some such sacrifice may be seen from the circumstance that both General Sir A. Cunningham and Mr. Melik Beglar have, in their time, submitted to such sacrifice.

How it happens that a department, one of whose chief

duties appears to be the preparation of careful, technically complete and accurate drawings of ancient monuments of an intricate nature, and the writing of reports thereon, has had no Engineers on its staff except General Sir A. Cunningham, now retired; and so far as we can learn, the present Archaeological Surveyor of Bengal, Mr. Melik Beglar, is a puzzle which will take another article to explain.

*(To be continued.)*

## RANGOON DRAINAGE SCHEME.

THE works for the sewerage of Rangoon on the hydro-pneumatic system, already fully described in our pages, are making good progress. The contract was signed on the 11th of November last, and the first shipment of materials and plant arrived within three months after that date, when the 21-inch outfall sewer to Monkey Point was commenced. Early in March the gravitating sewers were commenced in Block G, and by 11th May, when the pipe laying season was closed (on account of the rainy season), 1,540 yards were laid, completing the block with man-holes and junction stations. In the meantime 3,945 yards of the main outlet sewer had been laid, including the necessary timbering for carrying the sewer over canal and boggy grounds. The tubbing for ejector No. 21 was sunk and fitted with two ejectors ready for work.

The foundations for the boiler house and chimney stack, also compressing station are in, and carried up to nine feet above the site, which is low, which is the engine house floor level. In addition to the above, seven-and-three-quarter miles of pipes are at site of works; also eighteen of Shone's patent ejectors complete, with the plant and necessary materials for the works in progress. It has been arranged for the boilers and engines to arrive at the close of the rains, the remaining plant and materials will continue to arrive by every steamer leaving England for Rangoon.

The existing staff of Europeans will be greatly increased to meet the contractors' intention of having the works sufficiently advanced by the commencement of the next rains, to enable the Municipality to exterminate the ghastly night-soil carts. Messrs. Shone, Ault, Hughes and Lancaster, the contractors, are working with the intention of completing the system for the city with the supplementary high pressure water-supply by X'mas 1889, when invitations will, we hear, be sent to the leading sanitary authorities in India, inviting them to be present at the opening, that they may become acquainted with the working of the hydro-pneumatic system of drainage, the only system applicable for many towns in India.

The works when completed will it is expected cost something like 30 lakhs of rupees, and will add one more to the number of Engineering triumphs inaugurated for the improvement of Rangoon by the present Municipal Engineer—Mr. O. Deacon Clark.



## TIDAL OPERATIONS IN INDIA.

## III.

THE general principles of the reduction of the tidal observations by means of Harmonic Analysis consists in exhibiting the height of the tide at any time as the sum of a series, each term of which is a constant multiplied by the cosine of an angle, called the argument, partly made up of a simple function of the time, and partly dependent on the position of the sun or moon or both. Each of these terms arises from some specific cause in the elaboration of the equilibrium theory of tides, and is regarded as a separate tide due to this cause. Thus there are as many tides as there are terms in the series, and the height of each tide is equal to a constant multiplied by the cosine of a certain angle, the argument. The maximum value of the cosine being unity, the constant gives the greatest height above mean of the particular tide, that is, the semi-range or amplitude. The part of the argument due to the time is of the form  $nt$ , so that  $n$  represents the rate at which the argument increases, and is called the 'speed' of the tide. Also since the tide's maximum occurs when the remainder of the argument is equal to  $nt$ , this part of the angle divided by  $n$  gives the time which must elapse from the beginning of the observations till the high water of the tide, and is called the 'epoch' of the tide. Thus each tide is shewn in the form  $R\cos(nt - \text{epoch})$  and this is further simplified to  $A\cos nt + B\sin nt$ .

The immediate object of the reductions is to find  $A$  and  $B$ , from which  $R$  and the epoch can be deduced from the equations  $R^2 = A^2 + B^2$  and  $\tan(\text{epoch}) = B \div A$ .

For the purposes of reduction the tides are divided into two sets, short period and long period tides, and these sets are treated in different ways. The diagrams are divided into mean solar hours; the first step in the reduction is to read off the heights from the diagram for each mean solar hour during the 370 days, the period treated, and enter in a schedule for the solar series in which the speed of each tide is some multiple of  $15^\circ$  per mean solar hour. The other tides have not a period corresponding exactly to a multiple of  $15^\circ$ , so that occasionally two entries are made under the same hour space and at other

being available for Government or anyone else to operate on. He is, during the next two-and-a-half years, to sink not less than ten experimental wells of 500 feet deep, the Government to allow him Rs. 2500.

**THE FACTORY ACT IN BOMBAY.**—The Government have during the past few days been making inquiries into the question of the employment of women and children in the Bombay mills, especially with regard to the hours of work and the age at which children are tides these means requested that Lord Reay's Government that the heights entered in the schedule do not exactly correspond to mean solar hours, but are the means of the heights during a period from half an hour before to half an hour after the mean solar hour. From the resulting  $A$ 's and  $B$ 's the  $R$ 's and the epochs are found as before described. The mean of all the heights entered in the schedule of the solar series for the whole period

gives  $A_0$ , the mean level of the sea for the year of observation.

In the evaluation of the long period tides, the daily means of the height of tide are found from the schedule of the solar series, and  $A_0$  subtracted from each mean. The resulting quantities are multiplied by the proper cosines and sines, and the sums of the products found. These sums, two for each tide, are 'cleared' from the effects of the short period tides which have most influence on them; the 'cleared' quantities divided by the proper number of days give first approximations of the values of the constants for each tide. These first approximations are next used in the solution of the ten equations resulting from the five long period tides considered, and the final values of the constants are determined. The  $R$ 's and the epochs are then found as before. At present the number of tides considered is thirty-three, of which five are long period tides, but the number is only limited by the question of the expediency of calculating small tides.

If the tides are exhibited in the form  $R\cos(nt - \text{epoch})$  they are not comparable from year to year, because  $R$  is not strictly a constant, but depends on the obliquity of the lunar orbit, which is a varying quantity. The difficulty is got over by further representing the height of the tide in a series of terms of the form

$$f H \cos(V + u - \kappa).$$

Where  $V$  is a linear function of the moon's and sun's mean longitude, the mean longitude of the moon's and sun's perigee, and the local mean solar time at the place of observation reduced to angle at  $15^\circ$  an hour.  $V$  increases uniformly with the time and its rate of increase per mean solar hour is the  $n$  or 'speed' of the tide.  $u$  stands for a certain function of the longitude of the node of the lunar orbit at a time half a year later than the beginning of the first day. Strictly speaking, it should be taken as the same function of the longitude of the moon's node varying as the node moves; but as the variation is but small in the course of a year,  $u$  may be treated as constant and put equal to an average value for the year, which average is taken as the true value of  $u$  at exactly mid year.

Together,  $V + u$  constitute the whole argument according to the equilibrium theory of tides with the sea covering the whole earth, so that  $\kappa \div n$  is the lagging of the tide, which arises from kinetic energy, friction of the water imperfect elasticity of the earth and the distribution of

$H$  is the mean value of the semi-range of the particular tide in question, and  $f$  is a numerical factor due to the variability of the obliquity of the lunar orbit. It is clear that  $H = R \div f$  and if  $V_0$  is the value of  $V$  at the beginning of the first day, then  $\kappa = V_0 + u + \text{epoch}$ . It is obvious that if the tidal observations are consistent from year to year  $H$  and  $\kappa$  should come out the same from each year's observations, and hence it is possible to judge if the analysis is giving satisfactory results.

(To be continued.)

THE MELBOURNE EXHIBITION.—Every preparation is being made for the opening of the Centennial Exhibition on the 1st of August, and the work of arranging the courts has been commenced.



## Notes and Comments.

**BAD NEWS.**—We understand that Colonel Conway-Gordon is suffering so severely with his eyes at Simla that it is believed that he may take leave, if there is no improvement in his eyesight, before long.

**AN EMPTY HARBOUR.**—A Madras paper reports that there is not a single steamer in the harbour. On the Pier there is no work being done, and cargo and Masula boats are lying at their moorings idle.

**A WELL EARNED RESPITE.**—Mr. O. Deacon Clark, Municipal Engineer, Rangoon, is going home on three months' privilege leave from the 1st August next. Mr. Hall, the Assistant Engineer, officiates for him.

**SEREPORE ENGINEERING COLLEGE.**—This institution will close for the long vacation from 11th August till the 5th November next. Mr. Downing will be away during this period, and Mr. Bartlett will officiate for him.

**A WISE DECISION.**—The Municipal Commissioners, Madras, have finally decided that no foreign works should be executed in the municipal workshop, and consequently there will be no profits derived at the expense of private enterprise.

**CALCUTTA UNIVERSITY.**—Thirteen students from the Serapore Engineering College went up for the First Examination in Engineering of the Calcutta University, of whom 8 passed. The L. E. Examination ended last week, and the results cannot be out before next month.

**A COMBINED CHARGE.**—With effect from 16th May 1888, the Public Works Department of Rajputana and Central India will be worked as a combined charge under one Superintending Engineer, who will be Secretary to the Governor-General's Agent of both Administrations.

**GREAT FLOODS IN CEYLON.**—The result of the recent heavy rain up-country in Ceylon has been that the Railway was completely blocked beyond Peradeniya South by landslips, communication with the up-country by rail beyond Peradeniya was suspended, and the telegraph posts were washed away.

**RATHER A GOOD THING.**—The Burma State Railway has up to May last paid 2 lakhs to the Flotilla Company for freight on Railway stores to Upper Burma including passengers; the rates vary from Rs. 8 to Rs. 30 per ton; the former was paid for rails, and the latter for engines, the average rate was about Rs. 15 per ton.

**ABOLITION OF A TEMPORARY P. W. D. DIVISION IN BENGAL.**—The Lieutenant-Governor is pleased to direct that the Kalimpong Public Works Division shall be abolished with effect from the 20th instant. From that date all works east of the River Teesta will be in the charge of the Executive Engineer, Darjeeling Division.

**CAN IT BE TRUE?**—We learn that the Government of Madras have applied to the Government of India for officers for employment on the Periyar Project works. The staff required includes one superintending engineer, two executive and five assistant engineers, one mechanical and two sub-engineers, two supervisors and 11 overseers.

**MINERAL FINDS IN KABUL.**—Captain Griesbach, after having been detained at the Amir's Court until within the last month, proceeds to quite new parts of Afghanistan hitherto untrodden by Europeans. While at Kabul he was successful in finding a vein of Turquoise quite close to the City, and the working of that disclosed an auriferous reef of some promise.

**EAST INDIAN RAILWAY CO.**—At the annual general meeting of the East Indian Railway, to be held this month, the Board of Directors will recommend the payment of a dividend of 11s. 6d. per cent. on the deferred annuity capital, in addition to the guaranteed interest of £2 per cent. for the six months, making a total return for the year 1887 of £5 17s. per cent.

**A SATISFACTORY TRIAL.**—It is a long time, says the *Ceylon Observer*, since the Colombo breakwater presented such a magnificent sight as on the 26th ultimo, "when great waves came rolling in, and dashing themselves with terrific force against the outstretching arm rose to a height of over a 100 feet, and then descended from mid air in the form of lovely cascades."

**GOLD MINING RENTS IN MYSORE.**—The Mysore Government anticipate this year a small increase in its receipts from the Gold Mining Leases, from Rs. 35,000—the estimate of last year—to Rs. 50,000. This is considered a very modest estimate, since in 1886-87 the sum actually realised from mining leases was Rs. 51,248, and also that at present there is something like a "boom" in mining.

**LANDSLIPS AT DARJEELING.**—The Happy Valley Estate, over which a Commission of Government Engineers has been sitting, has been pronounced, so rumor says, to be in an imminently dangerous state. The Government Engineers have recommended an expenditure of two lakhs of rupees to arrest further mischief; but the wise men of Darjeeling consider this to be very inadequate.

**ENTERPRISE IN PERSIA.**—The Persian Government has lately given a concession to some Americans for the sinking of artesian wells. The concessionaires have the right of sinking wells in any part of Persia on ground belonging to Government, and will have certain rights on any land they reclaim and put under irrigation, and be able to sell water which they bring to the surface by means of their wells. An American hydraulic Engineer will soon be out to prospect.

**SIND PISHIN RAILWAY.**—A correspondent wires to us that in the articles on this line in London *Engineering* there is a strange omission of the rainfall in the comparison with the Ceylon line. He says that the contractor on the latter line told him that nearly half of the time of the construction was wasted owing to men being unable to work during the wet weather. The total period was 11 years, including long rest, during which no work was done for want of money.

the commencement of the next rains, to enable the Municipality to exterminate the ghastly night-soil carts. he Messrs. Shone, Ault, Hughes and Lancaster, the contractors, are working with the intention of completing the system for the city with the supplementary high ng pressure water-supply by X'mas 1889, when invitations on will, we hear, be sent to the leading sanitary authorities in India, inviting them to be present at the opening, that

UMARIA COLLIERY.—Our attention has been called to the paragraph in our last issue relative to this Government concern in connection with the remark that the figures are deceptive. We should like to see a full statement of the outlay incurred in prospecting this field, and the cost of the initial work, including plant, at the colliery, which, we understand, was opened out regardless of expense. We hold our own views on this undertaking, and hope some day to give them *in extenso*.



**ANGLO-INDIAN FIBRE COMPANY, LIMITED.**—This company, which is strangely named "Anglo-Indian," was registered on the 29th ultimo with a capital of £25,000, in £1 shares, to purchase from the British Flax Producers Company, Limited, all the patents and inventions relating to the treatment of flax and other fibres, assigned to that company by Edward Johnson, under an agreement of 14th January 1887, and all the machinery, plant, and materials in connection with the working of the same.

**AN OUTLET FOR BENGAL COAL.**—Singapore largely draws upon Japan for coal, the mines at Miike mainly contributing to these shipments. Last year the output amounted to 280,000 tons. The yield this year is not expected to exceed 250,000 tons, of which 150,000 will probably be required for Singapore and Hong-Kong. The demand for Singapore offers every prospect of increasing unless Tonquin coals come into competition. We might well ask—Why should not India enter into the competition?

**PROPOSAL FOR A NEW RAILWAY.**—Mr. Nobel, of petroleum fame, has come forward with a proposal to construct a broad gauge line from Umballa to Kalka, to be worked by the North-Western Railway, and a 2-feet gauge mountain Railway from Kalka to Simla. The Syndicate ask for the land, a lakh of rupees a year for carrying the mails and parcels, the use of the existing hill cart road with the regulation of the tolls, and they will undertake to construct and maintain the Railway without any guarantee.

the scheme will then prove a failure. The opinion of Colonel Pennycuik, who was deputed by the Government to inspect and report upon it, is strongly commendatory. The whole scheme of Madras drainage was enquired into 12 years ago by Mr. Clark, who designed and carried out the drainage works in Calcutta. His suggestions, no doubt, received every attention before the existing scheme was adopted. There is therefore so much the less reason for the employment of another drainage expert now as was recently suggested.

**PETROLEUM IN THE PUNJAB.**—Under the recent agreement between the Secretary of State and Mr. John D. Noble of Petrolia, the latter is to have the right of prospecting for petroleum in Northern Punjab. He is to be allowed to select five blocks of land, each with sides 4 miles long or 16 square miles of area. Each block to be locally distinct from the rest, the balance of the area being available for Government or anyone else to operate on. He is, during the next two-and-a-half years, to sink not less than ten experimental wells of 500 feet deep, the Government to allow him to do so.

**THE FACTORY ACT IN BOMBAY.**—The Government have during the past few days been making inquiries into the question of the employment of women and children in the Bombay mills, especially with regard to the hours of work and the age at which children are admitted. It is understood that Lord Reay's Government are as much in favor of legislation as Sir James Fergusson's Government were four years ago, and that representations with a view to general legislation, as projected by the Factory Commission of 1884, will shortly be made to the Viceroy.

**BANGALORE-GUNTAKUL RAILWAY.**—The question as to whether the proposed line of Railway from Bangalore to Guntakul shall be on the broad or metre gauge princi-

ple has been the subject of some discussion. The Madras Railway authorities have, it is believed, signified their willingness to construct a broad gauge line connecting the above-mentioned stations, but it would appear that the Government of Madras has recorded its disapproval of the proposition, although it is gratifying to observe that His Excellency the Commander-in-Chief is favorable to the proposal.

**NEW DRY DOCK FOR BOMBAY.**—The Trustees of the Port of Bombay have decided to make the new dry dock at the north-west corner of the Prince's Dock. During the prolonged discussion on the subject there have been several alternative schemes suggested. One by Sir Henry Morland—much favored by shipping people—was to make the dock outside the new Victoria Dock, and another was to construct it at the north-east corner of the Prince's Dock. The plan now finally adopted will curtail by one or two berths the present accommodation in the Prince's Dock.

**BENGAL-ASSAM RAILWAY.**—The survey of the Bengal-Assam Railway, which estimated the cost of the line at 651½ lakhs for a total length of 742 miles including branches, has been completed, and a satisfactory route for the line has been found through the North Cachar Hills. The Railway will open out the route into Upper Assam, and establish communication with the fertile and populous districts east of the Megna. The projected line runs from the port of Chittagong *via* Laksman, Bhardarpur, and Lumding to Makum on the Dibru-Sadiya Railway, and provides for branches from Laksman to Chandpur on the Megna, and from Lumding to Gowhatty.

**THE RECENT HAILSTORMS IN UPPER INDIA.**—The following appears in a recent issue of the North-West Provinces *Gazette*:—"The violent storm at Moradabad on the evening of the 30th April was accompanied by excessively heavy hail, which killed over 230 people, apparently by beating them down and freezing them to death. The Collector reports that all the deaths occurred in the open where there was no protection from the hail, but says that the individual hailstones were not larger than small pigeons' eggs. We believe it is on record in the archives of the P. W. D. that the corrugated roofing of some gun sheds at Morar were perforated and shattered by a hailstorm.

**THE MASONRY BRICK PEST.**—A correspondent writes:—"I send you a pill that will effectually cure Mr. Cleghorn's 'bivalve mollusks' of the family *Pholadina*, which prove so destructive, and to remedy which he undertook to write." The "pill" referred to is we believe a brick of a peculiar form intended for the water faces of the walls of the Kidderpore Docks, and it is therefore apparent that Mr. Duff Bruce was aware of the pest described by Mr. Cleghorn. Owing to the shortcoming of the E. I. R. we are not in a position to pronounce on the brick, the non-delivery of the parcel containing which is one more added to the many instances of faulty working in the traffic arrangements of this line.

**NEW BEERBHOOM COAL CO., LD.**—The Directors' report, together with the accounts closed to the 30th April 1888, of this concern, presented to the shareholders at the general meeting on 6th instant, discloses a most satisfactory state of things. After providing 12,673-9-0 for Branch lines the net gain on the half-year's working was Rs. 72,565-4-11, equal to fully 10 per cent. on the paid-up capital of



Rs 72,000, or say 20 per cent. Adding Rs. 1,458-9-6 to the net gain, and deducting payments of commission to Agents and Manager, transfers to Reserve Fund and carrying forward Rs. 4,063-14-5 to the credit of current half-year's accounts, the Directors were enabled to declare a dividend of 7 per cent., or 14 per cent. per annum.

**RAILWAY ECONOMICS.**—A contemporary writes:—Let it be remembered that the vital point in our whole Railway administration is rapidly becoming this question of expenditure and its control. It has become the fashion we hear to abandon active control now that comparatively high rates of dividend are shewn to be likely. The E. I. Railway is a proof that the payment of an 8 per cent. dividend on the year's working is possible even in spite of wasteful expenditure, and that with careful control, the dividend might be indefinitely larger. The importance of remodelling the controlling establishments, and of revising closely every considerable item of proposed expenditure, before sanction—cannot be too clearly recognized.

**DACOTS AND THE BURMA STATE RAILWAY.**—These wretches are making a new departure. On 1st July they attempted to wreck the up mail train from Rangoon to Prome by seizing the tools belonging to a permanent-way gang, beating the men and taking them away some distance, while the rest of the gang took up a pair of rails with their sleepers at 113th mile near Zegone, removed one rail from a bridge in that locality, and cut the telegraph wires. Timely intimation having reached the authorities, a special engine with police was sent to act as pilot,—and it got derailed when it arrived at the spot; the passengers were transferred to the down train, who proceeded to Prome, while the up returned with the Prome passengers to Rangoon.

**ARMY NEWS.**—The following is Royal Engineer Corps news:—Colonel R. G. Woodthorpe, C.B., recently returned from Bengal, has been posted to the India Office for special duty. Movements ordered:—Brevet Major the Honorable M. G. Talbot from leave on return from India to the S. M. E., Chatham. Ordered Home:—From Hong-Kong: Major A. De V. Brooke. Embarkation:—For Hong-Kong: Captain C. Wilkinson. The last *Gazette*:—Major William Percival Tomkins (late Bengal) to be lieutenant-col., vice Col. J. P. Steel, removed to the Indian Superny. List. Capt. and Brevet Major St. George Corbet Gore to the major vice W. P. Tomkins (late Bengal). Lieut. Hampden Hugh Massy to be capt., vice Brevet Major St. G. C. Gore.

**BANGALORE WATER-SUPPLY.**—In response to the advertisement of the Madras Government offering prizes of Rs. 2,000, twenty essays in all have been received, and a committee consisting of the Honorable Colonel J. O. Haisted, Colonel Ross Thompson and Lieutenant-Colonel C. Bowen, all of the Royal Engineers, have been inspecting for the past fortnight all the gathering grounds and drainage basins around Bangalore, alluded to or recommended in the several essays. General Fischer and the Mysore Engineers are, as might be expected from their knowledge of the country among the best of the competitors, but one or two others might be spotted for essays of great merit, and among the latter stands Mr. Garrett, Executive Engineer of Bellary.

**THE INDIAN GEOLOGICAL SURVEY.**—To the issue of the *Records* for February last Mr. Middlemiss and Mr. E. J.

Jones contribute papers, the first named gentleman dealing at some length with the crystalline and metamorphic rocks of the lower Himalaya, Garhwal, and Kumaon ranges, and Mr. Jones giving an account of his examination of nodular stones obtained by trawling off Colombo. There is also a Memorandum by Mr. Oldham on the results of an exploration of Jessalmer made by him with a view to the discovery of coal. But he only succeeded in finding sandstone—the speckled variety. "I cannot," he writes, "say that there is no coal in Jessalmer, but that is the extreme limit my observations allow me to go to." An unscientifically safe limit it is by the same token.

**NEW AGRICULTURAL IMPLEMENTS.**—Among the several implements submitted to the Department of Agriculture and Land Records for trial during the year 1887-88, the following were favorably reported upon by the Collector of Monghyr and the Sub-Divisional Officer of Mudepura: Sealy's patent turn-over plough, which turns up the soil to the depth of 8 or 9 inches, and so does away with hoeing. It is manufactured by Messrs. E. Sealy & Co., Motiharee and used by several indigo-planting firms. Price, Rs. 5-8. The Koontee plough valued at Rs. 2-8, manufactured by the same firm for up-rooting jungle of all kinds. It is used by some Indigo planters and found successful. The other ploughs with one exception are too expensive for the Indian ryot, and are not likely to be taken to favorably.

**RANEEGUNGE POTTERY.**—We are glad to find that Messrs. Burn and Co.'s stoneware glazed pipes are likely to be extensively employed for irrigation purposes in lately given a concession to some Americans for the sinking of artesian wells. The concessionaires have the right of sinking wells in any part of Persia on ground belonging to Government, and will have certain rights on any land they reclaim and put under irrigation, and be able to sell water which they bring to the surface by means of their wells. An American hydraulic Engineer will soon be put to prospect.

**SIND PISHIN RAILWAY.**—A correspondent wires to us that in the articles on this line in *London Engineering* there is a strange omission of the rainfall in the comparison with the Ceylon line. He says that the contractor on the latter line told him that nearly half of the time of the construction was wasted owing to men being unable to work during the wet weather. The total period was 1 year, including long rest, during which no work was done for want of money.

the commencement of the next rains, to enable the Municipality to exterminate the ghastly night-soil cart of Messrs. Shone, Ault, Hughes and Lancaster, the contractor for the East India Railway Company at any price; the Government of India, with more reason on their side, regard those of the North-Western State Railway as having the better claim to be considered: nor is it held desirable that the East India Company, already unmanageably strong, should be allowed to extend its operations beyond their present limit. We trust to find our Public Works' Minister as obstinate as a good occasion merits. But we have found him, to our cost, more inclined the other way.

**THE NEW WATKIN ANEROID BAROMETER.**—This wonderful instrument is the invention of Major H. S. Watkin, R.A., (the inventor of the famous Range Finder, and many other instruments adopted by the English



War Office,) and has only just been patented, the sole right of manufacture being entrusted to Mr. Hicks, who is also the maker of the Watkin Range Finder, &c. It is well known that Aneroids have been made of all sizes from 3 feet to  $\frac{1}{2}$  inch in diameter; the length of the divisions on the scale representing inches on the mercurial barometer have also been varied to suit different purposes; but inasmuch as there was only one circle of figures, either the number of inches, and therefore the extreme height at which the instrument was available had to be restricted, or the dimensions of the scale contracted in order to obtain a longer range. Major Watkin's patent index gets over this difficulty, and an open scale can now be obtained combined with great length of range. Thus in the 4-inch Patent Aneroid 1 inch on the mercurial barometer can be made to represent from 4 to 10 inches.

**MADRAS DRAINAGE SCHEME.**—The drainage scheme is the work of Mr. Jones. It was brought forward by him in 1879, and repeatedly considered between then and 1882, when the work was begun. The first portion was opened in 1884, and although as yet all the sewage does not run into the new sewers, a great deal of it is conducted to the new pumping station, and is driven from thence to a distance of two miles to the north of the City, where it is distributed over a large farm. The surface drains, which have so very much improved the streets of Black Town, have not yet been joined on to the sewers, for technical reasons. As soon as each sewer and the drains belonging to it have been completed and tested, the junctions will be made, and there seems no reason for apprehending that the scheme will then prove a failure. The opinion of Colonel Pennycuik, who was deputed by the Government to inspect and report upon it, is strongly commendatory. The whole scheme of Madras drainage was enquired into 12 years ago by Mr. Clark, who designed and carried out the drainage works in Calcutta. His suggestions, no doubt, received every attention before the existing scheme was adopted. There is therefore so much the less reason for the employment of another drainage expert now as was recently suggested.

**PETROLEUM IN THE PUNJAB.**—Under the recent agreement between the Secretary of State and Mr. John D. Noble of Petrolia, the latter is to have the right of prospecting for petroleum in Northern Punjab. He is to be allowed to select five blocks of land, each with sides 4 miles long or 16 square miles of area. Each block to be locally distinct from the rest, the balance of the area being available for Government or anyone else to operate on. He is, during the next two-and-a-half years, to sink not less than ten experimental wells of 500 feet deep, the Government to allow him Rs. 2,500 as compensation towards meeting the loss on such of the ten as have to be abandoned. The sole right to extract oil from the successful well is to be continued to him for 50 years from the present year, he paying to Government, as royalty, the value of one-twentieth part or Rs. 3 for every 315 pounds weight of crude oil removed from the site. If the operations are successful, the concessionaire is within five years to establish refining works at Rawalpindi, or some other suitable place on the North-Western Railway; the Government to provide 20 acres of land for the purpose, to purchase annually not less than 800 tons of lubricating oil at a stipulated price, and to carry all the manufactured products at specially favorable railway rates.

## Current News.

**LIGHTING** Dacca with gas cost Nawab Ahsunulla Rs. 1,50,000.

**THE** Railway Conference at Simla will probably be postponed till September.

**THE** Mysore Durbar has sanctioned Rs. 27,632 for restoring the Virupakshipur Bandur Tank of the Closepet Taluq.

**COLONEL** WOODTHORPE takes charge of the Intelligence Branch, Quartermaster-General's Department, from Colonel Bell, who goes on leave.

**A** PROPOSAL is under consideration to leave certain departments of the Supreme Government, such as the Telegraph Department, permanently at Simla.

**THE** Railway line between Dhak and Khusha, on the Sind-Saugor section of the North-Western Railway, was damaged by floods on the 4th instant.

**THE** quantity of cotton shipped from the port of Bombay during the month of May was 177,042 bales, weighing 69,375,214 lbs. and valued at Rs. 1,76,98,236.

**A** RIVAL telephone company in Burma has obtained sanction from the local Government to open out a new line in opposition to the Oriental Telephone Company.

**IT** has been decided to construct a pipe for the conveyance of petroleum from Khatum to Sibi, a distance of about 40 miles. The cost is estimated at 2½ lakhs of rupees.

**THE** total profits on the year's Jail Manufactures came to Rs. 2,42,741, against upwards of three lakhs in the previous year, the difference being fully accounted for by the Jubilee remissions.

**TRAFFIC** on the Sind-Pishin Railway has been suspended for ten days. A small flood has washed away three 40-foot spans. The piers, having no foundations, have disappeared down the stream.

**WE** understand that a series of works on Photography by Lieutenant-Colonel J. Waterhouse, Assistant Surveyor-General, will be published from time to time under the orders of the Government of India.

**PLANTERS** in the Teesta are inconvenienced by the Sikkim expedition and all its works. The military authorities are offering the seductive sum of fifteen rupees per month for coolies, with the result that the latter are quitting the gardens without furlough.

**THE** election of a successor to the late Sir Frank Souter on the Bombay Town Council took place at a meeting of the Corporation last week, with the result that Major Selby, R.E., received 30 votes and Mr. Geary 20. The former was accordingly declared to be elected.

**WE** learn that funds towards erecting a memorial to the Engineers of the Irrawaddy Flotilla Company, who have rendered good service and died in Burma, are being raised by members of the Engineers' Society in Rangoon and those employed in the Dalla Dockyard.

**THE** Madras Government have directed the building of the Victoria Hospital for caste and Goshia women, Madras, to be carried out by the Consulting Architect, the contribution on account of the Public Works establishment being fixed at five per cent. on the estimate.

**THE** works on the Assam-Bihar State Railway are going on rapidly. About thirty-nine miles were open for traffic in April 1887, and thirty-nine miles in February last. A further length, be it said to the credit of Mr. F. B. Walker, the Engineer-in-Chief of the line, will be opened shortly.

**MR. NOBEL**, who has settled the matter of exploitation of petroleum in the Punjab, has been allowed to assign a portion of his rights and interests to Messrs. Townsend Brothers and to Mr. McLellan of Karachi. Mr. Nobel is leaving by next mail in search of the plant and workmen from Canada.

**THE** memorial at Darjeeling in honor of the late Sir Ashley Eden is to take the form of an ornamental fountain on the *chowrasa*. Rs. 3,000 has been subscribed for the object, and the whole of the amount has been handed over to Mr. E. J. Martin, one of the members of the Memorial Committee, with full authority to spend it on the fountain.

**THE** forthcoming Poona Fine Arts Exhibition promises to be a grand affair, as we learn that the Government of India and the other local Governments have promised their cordial support. The Maharaja Holkar and the Mill Owners Association have each subscribed a sum of five hundred rupees for the same. Negotiations are in progress with the Railway Company for conveying articles for the Exhibition free of charge.



## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*

### INFORMATION WANTED.

SIR,—Can any of your readers give me the description of the hot air engine, and explain its arrangements and the way it works. If I could add a section of the engine I should be thankful to him.

HOT AIR.

CHANNERNAGORE, July 9, 1888.

### THE SEWERAGE OF THE FORT OF MYSORE.

SIR,—In Mr. Standish Lee's article on the above subject, which appeared in your issue of the 30th ultimo, mention is made of our Rancegunge glazed stoneware drainage pipes, and the writer says that in a trial consignment the breakages were so great, that although Indian pipes were cheaper, English pipes had been estimated for; this statement has caused us some surprise, as although the transshipments of goods between Rancegunge and Mysore are many, our pipes are, we believe, much stronger than Doulton's or any other English manufacturer's, and consequently breakages should be less than on the English imported pipes, and, as a matter of fact, we were informed that the pipes which we sent to Mysore arrived in good condition, with few breakages. We, therefore, think that the paragraph above referred to, must have been written on incorrect or insufficient information, and pending a reply to a letter which we are now writing to Mr. Standish Lee, we shall feel obliged if you will give publicity to this letter.

CALCUTTA,  
7, HASTINGS STREET : }  
5th July 1888.

BURN & Co.

### P. W. D. ESTABLISHMENT CHARGES, PUNJAB.

SIR,—In these days of financial pressure allow me to invite attention to the following facts and figures relative to the above named subject :—

	Rs.
Office of Chief Engineer and Secretary	1,04,182
3 Superintending Engineers with their Office Establishments	80,664
18 Executive and 31 Assistant Engineers	3,51,000
Upper Subordinate Establishment	62,400
Lower Subordinate Establishment	51,070
Temporary Establishment	18,520
Office Establishment of Executive and Assistant Engineers	87,680
Repayment of all advance contingencies and official postage	1,15,800
Examiner of Accounts and Office Establishment	35,648
Medical Establishment	6,204
Boat, Bridges and Ferries	5,500
Civil Officers' Accounts	4,932
<b>Grand Total. Establishments</b>	<b>9,24,600</b>

The Budget Estimate for Original Works during 1887-88	8,36,400
For Repairs, 1887-88	12,50,000

Total estimated expenditure	20,86,400
Being 48 per cent. on Works.	9,24,600

As the repairs consist of *kutchu* plaster, gobree leeping and whitewashing, and repairs to roads and bridges which, as a rule, a Chief Engineer never sees during his tenure of office, the percentage of establishment appears to be out of all proportion to the work to be done. Besides "Direction" of *kutchu* plasters, gobree leeping and whitewashing and road mending can hardly be said to be a very dignified occupation for a General Officer of the distinguished Corps of Royal Engineers, who is also a C. B. and A. D. C. to the Emperor!

CENSOR.

### MADRAS BREAKWATER.

SIR,—H. R. P. C. has found a soft point (!) in the plan of introducing cast-iron pipes into the concrete blocks. Cast-iron immersed in salt water is gradually softened, and after a time assumes a nature somewhat similar to that of graphite, but how long it takes to effect the change I cannot truly say. "Mr. Miller found that the rate of corrosion decreased with the thickness of the casting, being from  $\frac{1}{8}$  to  $\frac{1}{4}$  inch during a century in depth for castings one inch thick." In the case in question, the cast-iron pipes are only suggested as a means of strengthening the concrete blocks, and should it be found, after the lapse of a century or two, that the pipes were "graphitic" in nature, no doubt new pipes would be forthcoming. During the process of renewing the breakwater, this suggestion of minimising the shock of impact of wave might be tried in some exposed parts without any very great expense. Glazed earthenware pipes could be turned out by Messrs. Burn and Co. at their potteries and would be cheaper, but the salt water would take off the glaze in a short time. I should be glad to know whether there are not some very

extraordinary points of difference in the construction of the Madras and Colombo breakwaters? Is it true that the latter has a foundation of granite of some 150 feet width, which is diminished by a gradual curve to the visible top width? In the Colombo breakwater the courses of blocks are laid at a considerable angle to the vertical and break joint. In the Madras case the joints are, I believe, vertical and do not break joint. This has been reported but seems incredible. Some of your Madras correspondents can no doubt answer these queries. The width of Madras breakwater is also, I believe, much less than that at Colombo.

A. H. MASON,  
Executive Engineer.

DAMUKDIA E. B. S. R.; }  
July 4, 1888.

[Full descriptions of both these works have already appeared in this Journal.—Ed., I. E.]

### PRIZE COMPETITION.

SIR,—We have the honor to address to you a copy of a prize competition programme, with translation into English, for a practical manual of building hygiene in Dutch-East-India, issued by our Association, the contents of which we beg you to announce in your much esteemed Journal.

The Board of the Royal Institution of Engineers,  
Dutch East-India Section.

F. RESRIE, Lt.-Col., R.E.,  
President.

J. FRENKEL, Lt., R.E.,  
Secretary.

BATAVIA; June 7, 1888.

### PROGRAMME.

THE Royal Institute of Engineers, Dutch East-India Section at Batavia, offers a diploma and a prize of five hundred guilders for a practical manual for the application of hygiene on building in Netherlands-India, judged worth awarding. The Association for the Advancement of Medical Science in Netherlands-India adds a sum of five hundred guilders to this prize.

The judges will be composed of three members of the Royal Institute of Engineers, and two members of the Medical Association, chosen by their boards. The manual may be written in the Dutch, French, German or English languages, the competition is open to all.

All manuscripts must be sent prepaid so as to reach the Secretary of the East-Indian Section of the Royal Institute of Engineers at Batavia not later than the 1st October 1889. They must not be in the author's own handwriting.

If a competitor makes himself known in writing or in any other way before the award is adjudicated, he will be deprived of the prize, although having merited it.

Each manuscript is to be signed with a mark or proverb and accompanied by a sealed note, on which is written outside the same mark or proverb and a distinct mark for reclaiming them within, making known the name, quality and residence of the competitor. After the examination of the received manuscripts, which must be ended before the 1st of April 1890, they will be laid with report of the judges at public insight in the rooms of the Royal Institute during a month.

Unawarded manuscripts will be during six months at the disposal of the competitors. The copyright of the awarded treatise will become the property of the Institution.

Competitors are totally free in the treatment of the subject; however, they are advised to consider the utility of so dividing the manual in parts, that it might be possible to dispose of one or more of those single parts by special arrangement.

### WANTED—AN ENGINEERING LABORATORY.

SIR,—When looking around with a professional eye, one is frequently struck with the casual manner in which things are done in this country: we have only to observe the indifference displayed in the selection of building materials to find one out of many proofs of this fact. It is not in the case of large works that the indifference is so apparent—though even there all is not done that might be done; but it is in ordinary everyday work that either no check is had, or that the check is of hardly any value.

It is well known that adulteration is very largely practised in Calcutta. In the case of lime, for instance, this fraud goes on to a very wide extent, and it is impossible to be too careful when obtaining supplies of this material. The usually applied tests consist in placing a small quantity of the lime in a tumbler or bottle of water, stirring it up, letting it stand a while and then pouring off the water, and the sediment which is left is supposed to indicate the proportion of impurity contained in the lime; the other test is performed by tasting the lime and noticing the degree of acidity. Now these are *very rough* tests, and cannot be relied upon to determine the admissibility of a lime; besides considering the importance that should be attached to the strength of mortars in localities like Lower Bengal, where the soil is alluvial and yields unevenly, no superficial tests as to the value of a 'matrix' should for a moment be allowed.

Then, again, take the supply of Portland cement—a material of high importance, to the Engineer—we find White Brothers Francis's, Gillingham's, &c., having advocates each fully persuaded that the kind he uses is better than the rest; there would, as a matter of fact, be very little to choose between the productions of the best firms, provided there was no difference in the handling of the barrels from the time of leaving the factory till they reached the consumer. But what is so reprehensible, is the practice of



trusting to the maker's label being intact on the barrel, and not even taking the precaution of obtaining supplies from a trustworthy firm. A barrel of cement may have been originally very good, but have become almost useless through being kept in damp rooms, or by exposure to the weather, or even by long storage.

What is wanted for the satisfaction not only of Government, but of the Engineering profession and the public generally, is a laboratory where the fitness or otherwise of a building material can be tested. Such an institution becomes more necessary every day, owing to the increase of building operations in the metropolis, and the necessity to keep a check upon the work carried out and the materials employed by contractors, &c., both in Calcutta and in the districts.

Later on it might be interesting to your readers to discuss what such a Laboratory might consist of.

#### SCIENCE AND ART.

##### PROVINCIAL RAILWAYS IN BENGAL.

SIR,—In your issue of the 23rd June your correspondent "Non-Regulation" says that the late visit of His Honor the Lieutenant-Governor to Chota-Nagpore has not been unfruitful in the improvement of the material condition of that inaccessible country. His Honor has seen for himself the great wants of the country, and has ordered the execution of extensive public works in the shape of roads and bridges, and has promised all that he can do towards opening out the country to feed the Bengal-Nagpore Railway. For a ruler to undertake such trying journeys under the grilling hot sun to look for himself the pressing wants of a country is a matter of no small congratulation to the province whose destiny he sways. From this it can be inferred that other parts of the province under his Honor's administration which are suffering from a sad want of the means of communication, may in their turn claim a fair chance of their wants being looked into. The south-west part of Bengal comprising the sub-divisions of Jehanabad, Bishenpore and Bankurah in the districts of Hooghly and Burdwan and Bankurah have, owing to their difficulty of access, not been visited by any Lieutenant-Governor I believe. The formidable River Damoodah, which has to be crossed when attempting a journey to the country above-named, stands in the way of the idea ever being realised. Every discouragement is very likely placed in the development of the place should it even ever occur in the mind of any official. It is therefore very desirable that if in his autumnal tour His Honor made it a point of visiting this part of the country, he could see for himself the real state of affairs.

The formidable rivers Damoodah and Darkepur, which are broad dry sandbeds in the hot weather, and swollen torrents in the rains, have rendered the existence of the present district roads of the country entirely useless. Cart traffic is difficult at all seasons at the crossings of these rivers, and hence it is that the trade of the country is always in a dormant state, and is gradually falling into a final collapse. Nothing short of a Railway can remove the difficulties under which this part of Bengal has from time immemorial been laboring, and it is high time when North-East and Central Bengal are reaping, and the hitherto inaccessible country of Chota-Nagpore will before long reap, the full benefits of rail communication, that this part of His Honor's province should remain as benighted as it was under the Mahomedan rulers of the country.

We have now Mr. Martin, an eminent Railway Engineer, alive to the benefits of a Railway as head of the Railway administration of the province, and we trust that he will advise His Honor to undertake the extension of the Tarkessur Railway to join with the Bengal-Nagpore line, and thus open out a country which, though fertile, suffers from extreme inaction in trade owing to the formidable difficulties nature has saddled it with.

#### SOUTH-WEST BENGAL.

##### THE MASONRY BRICK PEST.

SIR,—I have read with great interest an article by Mr. Jas. Cleghorn on the above subject, and noted that the mollusk in question has been described as of the family *Pholadidae*. Upon referring to "Notes on Building Construction," Part III., Rivington's Series, I find the "*Pholas dactylus*" spoken of as a boring mollusk found in sea-water, which attacks limestone, hard and soft argillaceous shales, clay and sandstones. It also attacks wood, but not granite. Mr. Cleghorn's pest is evidently a relation. These mollusks are said to bore vertically, whereas the animal in question bored "at right angles to the face of the brick." This is only natural to effect an entry, and these Indian mollusks may perhaps tend to bore vertically after getting into the interior of the brick. Quoting from above book we read:—"By some it is supposed that they secrete a corrosive juice which dissolves the stone; others consider that the boring is mechanically done by the tough front of the shell covering the pholas. These animals are generally small, but sometimes attain a length of five inches. The softer the rock, the bigger they become. The shale beds, on which was founded the quay wall at Kirkcaldy, were so perforated by pholades that they crushed under the superincumbent pressure and a settlement resulted. The most notable instance of injury done by pholades is at Plymouth breakwater, where, in consequence of their attacks, the limestone blocks had to be replaced by granite." The plan suggested by Mr. Cleghorn of forming bricks with a receptacle to contain water would probably fail, as

the mollusks would bore the outside wall of the hollow brick, and upon reaching the interior, the water would of course flow out. Copper sheathing would probably be effectual only for a short time, as the mollusk would very likely get between the joints of copper sheets in its young stage. Moreover, the sheathing would decay. The best way for keeping off the "teredo navalis" from timber, is Bethell's creosoting process, and the probability is that some cement having tar as one of its ingredients would be found distasteful to Mr. Cleghorn's mollusk. A rough asphalt is often formed of sand, lime and tar, sufficient tar only being used to form a matrix. As the cement for repairs in question would have to set between tides, some Portland cement might be added in place of lime, but Mr. Cleghorn will know how to do this best. The plan, of course, is to use a material for facing the wall exposed between high and low water, which these mollusks do not like or cannot get through. Granite would answer the purpose. May I suggest the method of getting various kinds of the best hard building stones and materials obtainable in India, and exposing them in the same position exactly as the bricks in question, and noticing the destroying power that this Indian mollusk has on each particular kind. Such experiments would be of great use to the Engineering world. Would laterite with its large percentage of iron be of any use? It is probably too soft, but might be given a trial, with granite, trap, &c. Ordinary asphalt would probably suit the purpose if it could be made to adhere. A coat of coal tar laid on at once, and renewed when necessary, would prove in a few months whether these mollusks could be kept away by using a cement mixed with tar and sand.

No—SAM.

##### THE BENGAL NAGPUR RAILWAY.

SIR,—The introduction of the Railway system into India dates back but a few years—so few, that there are some of those who witnessed its introduction still living in the country. And the marvellous rapidity of its development, growth and extension is a matter for speculative thought. The giant limbs of that system now traverse the length and breadth of this great Empire, and each throb of its mighty pulse is possessed of such vital power, that the cost of its maintenance shrinks into insignificance when compared with its financial results, and the vast commercial and political influence it bears, not only to the so oft-quoted 95 millions of inhabitants of the country, but also to some of the greatest nations of the earth.

I have travelled over most of the principal Railways in India, and from experience, and personal acquaintance with employes on the different systems, have had an opportunity of experiencing not only the comfort and well-fare provided for travellers, but of learning something of their internal management. It is this experience and knowledge that induces me to jot down a few observations and hints in regard to the B.-N. Railway, in the hope that they will be of some benefit to travellers, and its employes hereafter.

The Railway is, I believe, designed to be one of the foremost in India, and the originators of the scheme intend that it shall be *nulli secundus*, either in point of commercial importance, or in its internal management. This is indeed an encouraging feature of its conception for those interested in its development, and for the Government of India, to contemplate. And not without reason; for connected as it will be with two of the oldest and best regulated Railways in the country—viz. the E. I. R. and the G. I. P. Railways that tap the country extending from east to west, and that run into the very heart of the two leading cities of the Empire—it cannot fail to benefit by the connection, and eventually, on its own merits, to open up the country—that is the whole of the Central Provinces—through which it will run. This country is rich in cereals and forest produce, and its "dark continental" feature has long lain dormant, while more fortunate provinces have already experienced the boon, and reaped the benefit of Railway communication. The B. N. Railway then is well adapted to dispel this dormancy—to import energy, vigour, education and enlightenment, for the want of which the inhabitants have lived content with their undeveloped resources, and almost barbarous simplicity.

We already have some proof of the sincerity of its promoters in wishing it to be a first-class Railway when we see all the material for its construction being brought out direct from home, and the high hopes entertained of it by the Engineering staff employed on its construction helps to inspire a confidence in the object that its promoters have in view. But not the least important object to have in view is, the system of management under which the Railway on its completion is to be placed—as the basis of that system will really be the foundation on which its future success will depend. Not a success merely financially, or commercially, but departmentally. For unless the departmental economy of the B. N. Railway can bear comparison with that existing on the leading Railways in India, the flattering hope that it will vie in reputation with those Railways, had better be smothered in the bud.

It is needless to criticise at length the economy of its present narrow gauge section, as that section will soon be merged into the broad gauge extension. But it requires no microscopic examination to lay bare its existing narrow financial policy. For the small salaries of its subordinate staff, and the imperfect arrangements made for travellers—which are sorely felt, in the want of



refreshment rooms, and the insufficient water-supply in waiting rooms, &c. speak for themselves on that score.

It would, however, perhaps be premature to discuss, or to forecast, the future economy of the B. N. Railway as a broad gauge line, as the high reputation of the man at the helm of affairs inspires the confidence that it will be such as to establish the model that the future B. N. Railway is prognosticated to be.

COMET.

### SIND-PISHIN RAILWAY.

#### I.

Sir,—I have delayed making any rejoinder to the recent articles in *Engineering* reprinted in your contemporary, although they contain much matter for reflection, and require to be taken very much *en passant*, for I was awaiting their completion, and the elucidation they have received in the shape of the leading article of 1st June in the same paper.

Before I touch on the articles in question, I wish to lay particular stress on the fact that I am in no sense a partisan. My only object is to clear up facts which have been too much obscured by partisanship. I am willing and anxious to ascribe all the merit to General Sir James Browne that he deserves. Even the exhaustive record furnished to *Engineering* of his services shows that he never had any experience of railway construction. He was at first quite unassisted by any Civil Engineers. Captain Scott Moncrieff, one of the gallant officers on the work, writes (Prof. Papers, Corps R. E. 1885, Simpkin and Marshall): "Many of us had had experience in the construction of barracks and forts, the laying out of military roads, some of us knew a little about canal engineering, but with two or three exceptions the R. E. officers sent up to the works knew nothing, practically, about the technicalities of Railway engineering; did not know how to lay out curves or set out bridges; did not know how to set out tunnels, and were quite ignorant of platelaying \* \* \* I shall try and point out the practical lessons which I, in common with others, learnt on this great work. It is better to have some idea, even if it be only in theory, of the work to be done, and not to have to learn it at the cost of disagreeable and humiliating failure as well as of valuable time." With all which I entirely agree.

Under the circumstances thus set forth by this most unprejudiced authority, I think the greatest credit is due to General Browne and his staff. Whatever may be thought of the wisdom of the Government which entrusts specialists' work to amateurs, there can be no doubt of the ability and skill, perseverance and energy of the R. E. officers who, undaunted by novelty or failure, carried through the enterprise.

They deserve all the praise that they got, or indeed that Captain Scott Moncrieff gives himself and brother officers.

But when this line, whose curves and grades are so sharp, that its carrying power is little more than half that anticipated, which has yet to have much spent on it to make it workable as a military line, is held up to an admiring world as the *acmé* and *ne plus ultra* of Engineering skill, it is incumbent on those who know the facts to criticize it in the mere interests of TRUTH.

I purpose therefore to run through the more prominent points in the articles under discussion, and to dispose of the inaccuracies in them, as well as to supply some omissions which hinder the correct apprehension of facts. If the articles in question were written for the purpose of justifying the late Engineer-in-Chief, they would scarcely be worth replying to even as a specious piece of special pleading, but if one of the leading engineering journals publishes them on its own authority as fact, in justice to the Railway Engineers of India, who are credited or discredited thereby, it becomes necessary to criticize the statements so recklessly made which abound in these articles.

In the first place, the difficulties of the country are on the face of them greatly over-coloured. Quite apart from the fact that not a single soldier is now kept on the whole line to protect it, and that outrage is unknown, if, as stated in the opening exordium, the country is devoid of food, water and fuel, and has but very few inhabitants and no resources, why should the distribution of labour be attended with so great military risks from the hill tribes. Secondly an attempt is made to shew that extreme haste was the reason for neglecting the niceties of engineering practice, and the Penjleh incident of 1885 is dragged in to prove urgency.

Now, the line was begun in 1879, was abandoned under orders of Mr. Chamberlain's Government in 1880, was started as the Hurnai Road concerned in September 1883, at which time General Browne was appointed.

It was perfectly well known that at least four years would elapse before the rails could be got through.

What the Penjleh incident of 1885 had to do with the way in which the Railway was designed it is hard to see.

Thirdly, it is maintained that the Engineer-in-Chief had nothing to do with the selection of the line, while in the exhaustive account given of his professional services, I find "in 1876 he had made a Railway survey of the Cutchee Plain and Mughkaf and Basse Poonas as far as Quetta." As this is so obviously the most important, easiest and direct line, surely it would have been within his province to inform the Government of India accordingly.

However, I must repeat that I do not wish to follow any personal questions relating to the Engineer-in-Chief.

Here, however, are the facts (1) as given by London *Engineering*, (2) as extracted from the Government returns; and I would be glad to hear of any other officer who was posted to the line.

From London *Engineering*.

As to the statements so recklessly made, concerning the inexperience of the staff employed on the Railway, they are easily disposed of by a few hard facts.

Concerning the Superintending Engineers employed.

One had worked on Railways, and Railways only, in England, India and America for 22 years; and had previously been Chief Engineer of many lines in India. The other had served some 12 years on Railways and had also been an Engineer-in-Chief.

Of the fifteen Executive Engineers employed. Twelve had spent their whole service on Railways, and three had acted as Engineers-in-Chief.

Of the thirty-three Assistant Engineers employed. Fourteen had been on Railways all their service, twelve were Assistant Engineers of the Provincial, Military or Irrigation branches of the Public Works, and six were Royal Engineers belonging to Sapper companies.

As to the remarkable statements made, that much waste of money was caused by General Browne being allowed to select his own staff, suffice it to say, that out of the fifty-one officers employed, two were applied for by him as having long frontier experience.

Officers Posted to the S. P. Ry. From Government "Gazettes," with their length of service on the Railway up to March 1887.

Posted. Service. Y. M.

Col. J. Browne Sept. '83

Major Shepherd

R. E. ... Feb. '85 2 3

This officer was promoted Superintending Engineer, temporary rank, in 1886.

R. Ramsay, C.E. '85 1 1

Had been Superintendent Works.

If there were any other Superintending Engineers posted to the line, we should be glad to hear of them. We have searched in vain for the gentlemen described in the parallel column.

Executive Engineers.—

Posted. Service. Y. M.

Capt. Hoskyns,

R. E. ... Dec. '83 2 8

Capt. B. Scott,

R. E. ... Nov. '83 3 6

J. Anderson ... Jan. '84 1 6

J. Campion ... Sep. '84 1 2

Capt. Whiteford

R. E. ... Mar. '84 3 4

F. Gilbert, ... Jan. '85 1 3

Capt. Connor ... Feb. '85 1 8

Col. Peters, R. E., April '85 1 0

Col. Shadbolt ... Aug. '85 1 5

Major Shepherd

S. C. ... Oct. '86 0 7

C. W. Hodson April '86 1 0

F. Rogers, ... June '86 1 6

E. Curry ... " '86 1 9

Capt. White, R. E. Sep. '86 1 9

Babu B. M. Bose June '86 1 9

We cannot discover which of these gentlemen has acted as Engineer-in-Chief, although their record is open to the public.

Assistant Engineers.—

Posted. Service. Y. M.

Lt. Scott Moncrieff, R. E. ... Nov. '83 1 8

Lt. Cowie, R. E. ... " '83 3 8

Lt. Thackwell, R. E. ... " '83 3 2

Lt. Capper, R. E. ... " '83 2 0

R. W. Egerton ... Dec. '83 2 1

Lt. Stewart, R. E. June '84 1 3

F. J. Pope ... Sep. '84 2 6

E. H. Tuck ... " '84 2 9

W. A. Johns ... Oct. '84 3 6

R. Woods ... " '84 2 5

G. P. Rose ... Nov. '84 2 6

Lt. Macdonald, R. E. Feb. '85 1 6

Lt. Walton, R. E. ... " '85 2 5

Lt. Craster, R. E. ... Mar. '85 2 4

Lt. Elliott, R. E. ... May '85 3 0

F. D. Fowler ... Sep. '85 1 6

W. Drew ... Oct. '85 2 6

F. Roberts ... May '85 1 10

A. Savory ... June '86 0 9

Babu K. P. Sen ... July '86 0 0

C. J. Cole ... Aug. '86 1 6

Lt. Birdwood, R. E. ... " '86 0 5

R. Perceval, ... Sep. '86 0 6

W. Weightman ... " '86 0 6

These are all the names I have been able to discover after an exhaustive search of the Government *Gazettes*, and as the numbers of Superintendents and Executives agree with those given by the writer of the articles in *Engineering* I may presume they are correct. I find then, that supposing Messrs. Ramsay, C.E., and Major Shepherd, R. E., are the officers alluded to, neither came to the line till 1885, and one only stayed a year, when he left (if I am correctly informed) because he disapproved of technical matters he was not allowed to alter.

While the senior of the two, Major Shepherd, had but 22 years' service when he came to the line, and had officiated as Engineer-in-Chief on the Rewari-Ferozepore line for some months.

This disposes summarily of the "hard facts" and leaves a disagreeable impression as to the candour and accuracy of the writer of the articles in London *Engineering*. It is easy, judging from the knowledge of General Browne's service, of the locale and



history of the line, and of the action General Browne took with regard to selection of staff, &c., to guess who is the author or inspirer of these articles, and it is a pity that more accuracy was not shewn in a paper which professes to set right the "reckless statements of others."

VERITAS.

#### BANGALORE WATER-SUPPLY SCHEME.

SIR,—There is considerable excitement here over the criticism of mine (which appeared in my last "Notes from Madras") on General Fisher's water scheme for this place. There appears to be something "fishy" about that scheme: there are evidently some parties here who are personally interested in its being carried out. The *Daily Post* (a local paper) is a hot advocate for it, while the *Bangalore Spectator* is more an advocate for facts and figures. On the 23rd ultimo the *D. P.* again alluded to the scheme, and remarked that it was a significant fact that no one had been able to point out any defects in the scheme. He must have made this remark, well knowing what had appeared in *INDIAN ENGINEERING*, for he must have had an eye on your paper after the publication of General Fisher's scheme in it. The *B. S.* was promptly down upon him, and on the 27th ultimo reproduced my criticisms from your paper *in extenso*. On the 29th the *D. P.* replied to the *B. S.*, trying to rebut the criticism with what he fancied even arguments; but so dissatisfied was he with his case, that he descended to abusing the counsel on the opposite side—he called your *own correspondent* the creature of *Bangalore Spectator*—the fact being that the *B. S.* does not know who your "own correspondent" is. I have not seen the *D. P.*, as I do not get the paper, nor do I know anyone who does. What I have learned is from the other paper. I have not troubled myself to get the *D. P.*'s issue of the 29th, as if I sent to the office for it, they would immediately "smell a hare." Besides, I have no intention of replying to their reply unless it appears in your paper. I would have taken no notice of the General's scheme if he had not had the hardihood to publish it in your paper—and being a scheme connected with my Presidency it came within my scope. As it was, I let the old man down as easy as possible. I only criticised one feature—the most important—of his scheme. I could have pulled the others to pieces too. I only mention all this to let you see that your influence is beginning to be felt in these parts. I should be sorry to see another gigantic failure here like General Sankey's—it would be the ruin of the place—might lead to its abandonment as a military station; and General Fisher's scheme is transparently absurd. That more water might be got to flow into the Hebbal tank than does at present, may or may not be a fact; but certainly merely increasing its capacity will not bring more water into it, any more than substituting a big cash chest for a small one, will bring more money in to a man.

It is a curious coincidence that the letter of "One who knows" reflecting on the way the General is trying to push his scheme should have appeared in the same number as my criticism. I do not know who the writer is, but he is evidently one who does know.

I hear eighteen schemes have been submitted to Government for the water-supply of the place, in response to the advertisement which appeared in your columns, and Colonel Hasted is coming here to enquire into some of them himself.

YOUR "OWN CORRESPONDENT."

BANGALORE; July 3, 1888.

#### MOORE'S IMPROVED CAST-IRON SLEEPER.

SIR,—Mr. G. E. Moore far from explaining satisfactorily the various defects which appeared to me at first sight, has indulged in statements, which tested in the alembic of logic very materially support my position.

I shall deal with his explanatory notes *seriatim*.

1.—His assurance as to the absence of wear and tear in the rail table in contact due to oxidation and other causes is opposed to facts and inconsistent with the theory advanced by himself and admittedly right. In his specification he distinctly declares that steel oxidises rapidly when exposed to damp, *ergo* sleepers made of that metal are not suitable for damp climates.

If this is correctly put by me, then steel on iron exposed to damp and further to actions chemical and mechanical is bound to suffer to an appreciable extent. I have witnessed, and Mr. Moore cannot be ignorant of the fact, that the H section rails, when taken out of ordinary cast-iron chairs, not so imbedded in ballast as the improved cast-iron will be, shew grooves on the rail to the extent of contact, varying from a depth of  $\frac{1}{16}$  to  $\frac{3}{16}$  of an inch. Surely in the face of these facts Mr. Moore does not mean to maintain that the rail in his improved sleeper will be quite rigid in its bed, and there will not be a certain amount of oscillatory movement in the rail *in situ*?

If he admits this, the exposure to damp and the operation of actions chemical and mechanical, his assurance on this head loses its validity.

2.—Mr. Moore has evidently not studied the mechanical forces which come into operation when a train is travelling round a sharp curve at speeds consistent with safety. He is doubtless aware of the super-elevation of the outer rail on curves on Railways

and its necessity, and further he is aware of the fact that on such portions of the roadway there are two principal forces which come into action—one due to the force called centrifugal, the other centripetal—both of which with their attendant and resultant forces have a tendency to displace the outer and the inner rail; and if these forces were allowed their sway unrestrained, the rails with their appendages (particularly those within the gauge) would be completely overturned. It is the operation of these and like forces which draw the ordinary spikes in the creosote pine sleepers; and it is for the prevention of the constant drawing of the spikes induced by such forces as oscillatory, centrifugal, centripetal, sliding, grinding and many others, that the keyman is employed on Railways—a fact well known. These identical forces tend to the destruction of the metal of the vertical webs above the inside cotter slits in the D.-O. sleepers.

3.—Mr. Moore must know that, notwithstanding the extra strength imparted by the stout vertical webs above and below the plate, and the through tie rod, the D.-O. sleeper often breaks cross-sectionally; and therefore the absence of these aids to strength—unless otherwise provided for in his sleeper—is a feature which mars the efficiency of this otherwise useful sleeper.

4.—If the accuracy of the various parts forming the sleeper and the rails can be ensured, the defect pointed out by me under this head would disappear.

5.—The friction between the end of the tie bar and the rail web admitted—wear and tear follows—be the amount however small it may—leading to disturbance of the *originally accurate* gauge.

In concluding, however, I cannot avoid admitting the excellence of the combination christened by Mr. Moore, and if he will by experiment remove some of the most serious defects which disfigure his sleeper, I do not see why it should not find ready sales in this and other tropical or sub-tropical countries where wood and steel are prohibitive constructive materials for Railways.

RAILROADER.

## Literary Notices.

THE TESTING OF MATERIALS OF CONSTRUCTION. By William Cawthorne Unwin, F.R.S., M. Inst. C.E. London: Longmans, Green and Co. 1888.

THIS work is intended as a text-book for the engineering laboratory. The first part treats of the mechanical properties of materials—that is the phenomena of elasticity and plasticity, and the relations between stress and deformation, so far as they have been scientifically ascertained. In the second, the apparatus used in the engineering laboratory is described. Tables of results of various experiments are also given. The second part is by far the most interesting; as the first necessarily traverses a good deal of old ground: in it we are re-introduced to our old friends M, E and I and other symbols belonging to the *Theory of Strains*.

Drawings of various testing machines in use at home, on the Continent, and in America are given. These drawings are well executed, and the descriptions are clear. It will open the eyes of such Engineers as have not had much to do with this detail of their profession to see the magnitude and complexity of some of these machines, and the ingenuity which has been expended upon their creation.

The author distinguishes between scientific and commercial or qualitative testing. The object of the former being the determination of the physical constants of the materials and the verifying of assumptions on which theoretical calculations proceed; while that of the latter is to ascertain whether samples of a material comply with certain arbitrarily chosen standards of quality.

The materials dealt with are those usually employed in engineering works—metals, timber, stone, brick, lime and cement.

We commend the book to the notice of Civil Engineering Colleges and similar institutions; also to such Engineers as desire to acquaint themselves with the methods by which the tables they are accustomed to use in calculating the strength of their materials have been arrived at. We must warn them, however, that it will not enable them to carry out experiments for themselves—at least not in this country—the plant required being beyond anything they could hope to command here. What it will do will be to satisfy the nervous that the tables they are in the habit of using have been arrived at with great care, and the exercise of much skill. But they may take our word for that.



## General Articles.

### THE SEWERAGE OF THE FORT OF MYSORE.

By STANDISH LEE,

Sanitary Engineer, Mysore State.

#### II.

EXPERIENCE has shown that sewage is not discharged from houses at a uniform rate throughout the 24 hours, nor even throughout the day time;—the maximum flow being during 2 or 3 hours in the morning and for about the same time towards evening. The quantity of water, provided for in the water distribution scheme, is 20 gallons per head; and the sewer pipes are calculated to discharge when running two-thirds full, not less than 1½ c. ft. or 935 gallons of sewage per head of the population in 6 hours, or 6 c. ft. in 24 hours. In estimating the population, 10 per cent. has been added for prospective increase, though the tendency is to reduce the number of people living within the Fort, by inducing them to remove to and build on the open ground to the west of the town. A certain quantity of rain-water, from court-yards and house tops, must find its way into the sewers, but, in the system proposed, it is not considered necessary to provide rain-water outfalls, as the pipes on becoming filled by flood-water will discharge their contents at all the street gullies, which will act as so many safety valves and protect the pipes from bursting. The system, as a whole, is capable of conveying in 24 hours, when running full, 70 gallons per head of the population, which allows a margin of 50 gallons of rain-water per head.

The average frontage of houses in the Fort is about 30 ft., and the average number of people to each house is 69. Thirty feet of a street, with houses on both sides, will therefore contain 14 people, or 2,464 per mile. If, therefore, 2,464 be multiplied by 20 gallons, it will give the discharge of sewage in 24 hours at 49,280 gallons or 35 gallons per minute. But a pipe sewer of 6" running ¾ full with a gradient of 1 in 300 feet, would discharge 134 gallons per minute. It therefore follows, that a 6" pipe-drain is too large for the drainage of one mile of a street with houses on both sides, even in such a crowded locality as the Fort.

#### HOUSE CONNECTIONS.

Dr. McGann has very properly laid down, as a fundamental condition for house drains, "That there must be *disconnection* by means of a trapped 'gully or other means, at the *house-side* of the trap, and means for ventilation at the *street-side* of the trap' \* \* unless this be effectually done, the system must be condemned at the very start."

In new houses in England the above conditions are secured, as shewn in *fig. 1*, Plate IV. Here the pipe from the sinks does not enter drain or sewer direct, but delivers over a small gully-head connected with a drain.

The application of this principle to the houses of Mysore is shewn by *fig. 2*, Plate IV. The position of the gully in this arrangement is on a level with the basement of the houses, which range from 1 to 3 feet above the street level. At this height rain water from the street cannot enter the pipes, and therefore no road-detritus will be washed into them. Being situated by the roadside its management will rest entirely with the Municipality, and will prevent the possibility of foreign substances being introduced into the sewers by the inmates of the house.

The ventilation of the street or sewer side of the trap will be effected by carrying up ventilating pipes outside the building, to a height well above the windows of the house, as shewn by *fig. 2*, Plate IV. The gully-trap itself, with the ventilating hole, is shewn on an enlarged scale at *fig. 3*.

The most approved method of ventilating and trapping soil-pipes and house drains, known as "Banner's Patent," is illustrated by *fig. 1*, Plate V. D is the inlet of a small tube by which external air is led into the soil-pipes

immediately above the Patent Drain Trap B, thereby admitting, by the patent cowl fixed on the top of the soil pipe carried above the roof, a constant current of fresh air throughout the whole system of soil pipes of the house. E shows the same plan extended to the sewer by means of which the present road or street "ventilators" would become *inlets*, whereby a constant current of fresh air would be created and accelerated by the action of the cowl fixed on pipes carried up outside the house, and causing not only the house and street drains, but the sewer itself to be always pure.

In the arrangement shewn at *fig. 2*, Plate IV., a pipe drain is adopted; but as connections of this description are expensive, and the necessary means for providing them may probably be out of the reach of many, a simple and inexpensive alternative arrangement is also shewn in Plate VI., *fig. 1*. This is an ordinary open-drain, so arranged as to start from the most convenient part of the house and to pass under the main entrance of the building to the street pipe.

In small houses without court-yards, and in the case of huts, there will not be a connection for each individual house or hut, but only one connection for each group. This system has been tried successfully in the "bustees" of Calcutta, and is shewn by *fig. 2*, Plate VI.

In those cases where this expedient cannot be adopted, an apparatus, used in connection with the London sewers, and illustrated in Plate VI., *figs. 3 and 4*, will be provided. It is a form of ventilator which may be fixed at any intermediate level, between ground line and top of ventilating pipe, to purify the gas before it is discharged, so that when the windows of a neighbouring house are within the influence of a ventilating pipe, the tenants may not be injuriously affected by its action. Charcoal baskets are similarly provided at all ventilating grates, Plate III.

#### STREET OR PRIMARY DRAINS.

The inclinations given to these drains are such as will secure, in each instance, a velocity of over 3 feet per second, which is now the accepted rule as to the velocity necessary to make small sewers, from 3" to 12", self-cleansing; but as a regulated fall alone is not sufficient to preserve them clean and wholesome, flushing with water, at regular intervals of time, is necessary, and the plan proposed is illustrated in Plate III., *figs. 3 and 4*.

The depth, at which the pipes are proposed to be laid, is the least that can be given consistent with their safety, and is regulated by level of house junctions, flushing arrangement, gradient of pipe, and fall of ground, &c.

Every precaution, as has been shewn, is provided to prevent the introduction of, and to detect the presence of, foreign substances in the drains; but as accidents may, notwithstanding, occur, and as it is necessary that the "*modus operandi*" in cases of stoppages should be clearly understood, an illustration is given in Plate VII., *fig. 1*.

A lighted taper is suspended in the lamp-hole L, and a man is sent down the man-hole M, with tools specially adapted to the work. The sewer being laid in a straight line between the man-hole and lamp-hole, the man is able to judge whether the line is clear or not, as when there is an obstruction, he will not be able to see the light at the lamp-hole. The figure shows the man as about to remove the stoppage. While this operation is going on, there will be no complete stoppage of the sewage, as alternate lines for its discharge are provided. For instance, let the stoppage take place at B, *vide* Plate VII. The flow down B, C will thus be stopped. The fall from M to B is 2½ feet (*fig. 3*) and immediately sewage fills the pipes to that extent, the remainder will flow along the connecting pipe M, D, and find its way into the secondary sewer through the parallel street drain D, E.

The tools required for keeping a system of sewers in working order are also illustrated by *figs. 4, 5, 6, and 7*, Plate VII., and consist of jointed hoe, gully tool, four-bladed rake and semi-circular shovel. The handles are interchangeable, and are attached to each other, for



Removing obstruction from Pipe-Drain

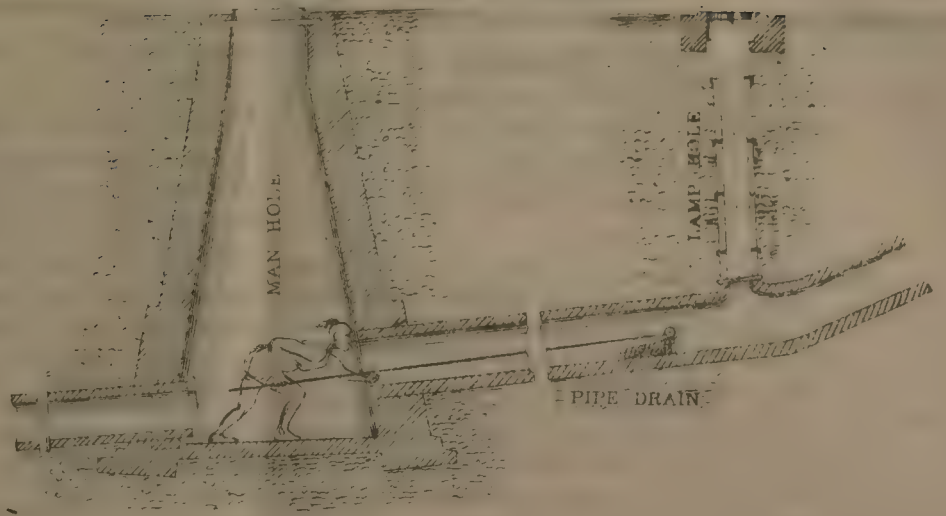


Fig. 2.

Showing use of connecting pipes

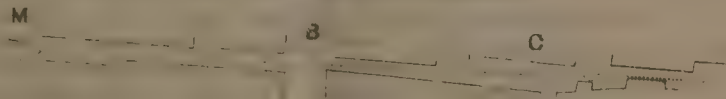


Fig. 3.

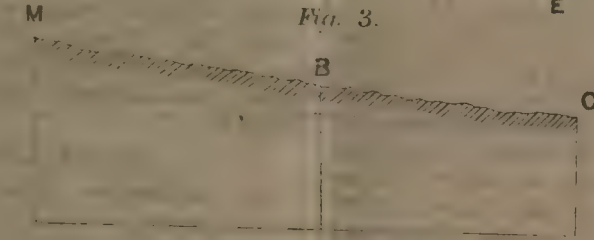


Fig. 4.

TOOL, S. L. IN CLEANING SEWERS

Shovel.



Fig. 5 Rake.

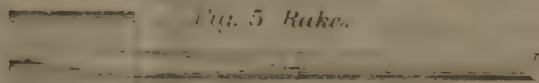


Fig. 6.

JOINTED POE



Fig. 7.

GULLY TOOL.

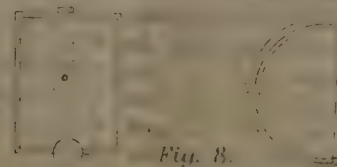


Fig. 8.

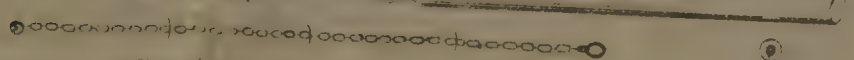


Fig. 9.

Disc Plug.



REPRESENTS

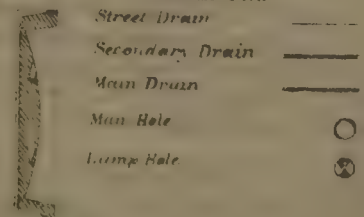
Street Drain

Secondary Drain

Main Drain

Man Hole

Lamp Hole



The trap shall be by the house at the







lengthening, by a bayonet lock. The disc plugs for each size of pipe are of stone-ware, *fig. 9*.

One other method of removing silt from bottom of pipes is for a long rattan, with a small line attached, to be forced through to the next man-hole, and the line made to draw a light chain with discs on it, *fig. 8*, which by being drawn back and forward scrapes out the sand, and causes it to be carried away by the flow of water in the pipe.

House-junctions for present and future requirements will be carefully provided during construction, and those not brought into immediate use will be closed by stone-ware blocks, and a record of the exact position made in a book to be kept for that purpose.

#### SECONDARY SEWERS.

There are three secondary sewers, one for each drainage section. They receive the contents of all the street or primary drains, and the house pipes, of the streets in which they are laid, discharge direct into them. Their position, as intercepting sewers, is regulated entirely by the street drains that discharge into them, and they start from about the middle length of each drainage area.

As the volume of sewage passing through them will, at all times, be considerable, and the flow more uniform than in minor pipes higher up in the system, they are laid at a less gradient than the street pipes.

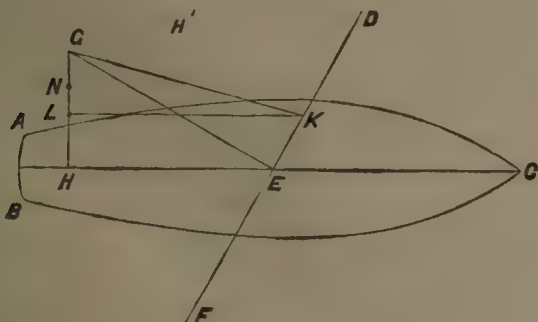
(To be continued.)

### NOTE TO ARTICLE XIV. ON PROPERTIES OF FLUIDS.

BY A. EWBANK.

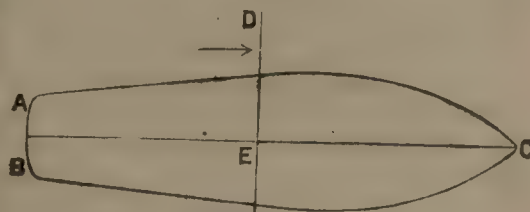
A COURTEOUS correspondent has directed my attention to the fact that the investigation is incomplete in the case where the wind blows in one direction, where the real wind force on the vessel is felt in a second direction and where the vessel moves in a third direction. This case was in the text illustrated by *fig. 47*, which is here reproduced.

*Fig. 47.*

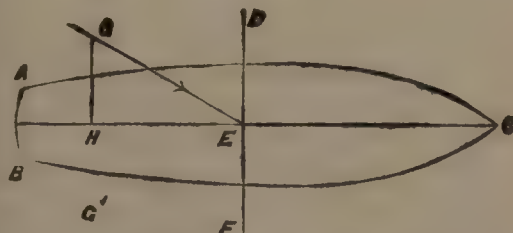


The incompleteness to which he draws attention is as follows: In the text account is taken of the fact that when a wind strikes a sail obliquely part of the force is wasted. But in the text another element is omitted. The sail is of given area, and when after the sail has been struck normally by the wind, we alter the direction of the sail—the wind retaining its direction unchanged—we do by this trimming of the sail really lessen its effective surface. Fewer particles of air will now strike the sail, and these fewer particles strike obliquely, while the original and more numerous particles struck normally. There is thus a double weakening of the wind force actually felt, but only a single weakening is recognised in the text. This criticism is just, and in any attempt to compare quantitatively the values of the two wind forces—viz. the wind force when the wind strikes normally and the wind force when the wind strikes obliquely—we should certainly take the double weakening into account.

*Fig. 44.*

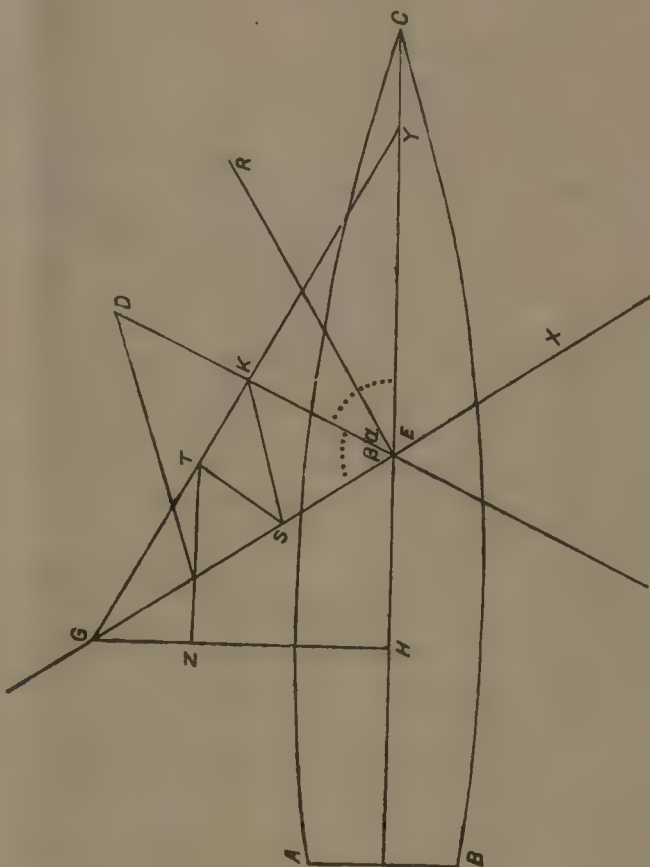


*Fig. 45.*



A similar criticism would apply to the case of *fig. 45* as compared with *fig. 44*. The investigations in article XIV. were not intended to be complete, but still they look as if they had been so intended, and I feel obliged to my correspondent for drawing my attention to the point. As the question has thus been raised, we may indicate a more complete solution. I say "a more complete solution," for even the one now to be submitted is not perfectly complete. My correspondent adds, that the best arrangement for the sail is not an easy matter to find. The question however admits of solution for the case of which

*Fig. 47a.*



he treats. In *fig. 47a*\* the median line of the vessel is along EC. GE is the wind direction and GE measures the wind force on a sail whose plane is normal to GE. The sail thus normal to GE is denoted by ER. The plane of the sail is now supposed to be turned into some other position denoted by ED. The plane of the sail is in.

\* It should be noted in this diagram that ST is the arc of a circle, GT is equal to GS, and the line from D to ZT is unnecessary. —Ed., I, E.



each position normal to the plane of the paper. The wind has a given constant force, and has a given direction E X. The ship has its head pointed in a given direction E C. The only element left variable is the position or trim of the sail. Thus in the figure the angle  $\alpha + \beta$  is known. But the value of  $\alpha$  is unknown, and hence  $\beta$  is unknown. It is required so to choose  $\alpha$ , that is, so to place the sail, that the vessel may derive the maximum propulsions from the wind and in the direction E C. The rotations of the sail through the angle RED lessen its area as viewed along G E. Instead of the original area we have this area projected, and the wind force that was G E becomes from this cause alone  $G E \cos RED = G E \sin \beta$ . This wind still acts along G E, and in order to estimate the weakening due solely to the air particles striking the sail obliquely, we must take the wind force to be now  $G E \sin \beta \times \cos E G K$ . G K is drawn perpendicular to E D, and  $E G K = D E R$ . Thus the doubly weakened wind force becomes  $G E \sin^2 \beta$ . In the figure  $G K = G E \times \sin \beta$  and  $G S = G R \sin \beta = G E \sin^2 \beta$ . Make G T along G K equal to G S. Thus G T denotes the doubly weakened wind in magnitude and direction. If now we project G T on the median line, we get the component  $G E \sin^2 \beta \cos Y = G E \sin^2 \beta \sin \alpha$ .

Thus we require  $\sin^2 \beta \sin \alpha = \text{maximum}$  when  $\alpha + \beta$  is constant. Differentiating and dividing by  $\sin \beta$  we get  $2 \cos \beta \sin \alpha \cdot \delta \beta + \sin \beta \cos \alpha \cdot \delta \alpha = 0$ , and  $\delta \beta + \delta \alpha = 0$ .

These equations give

$$\tan \beta = 2 \tan \alpha.$$

If for the known  $\tan (\alpha + \beta)$  we write  $m$ , we have

$$m = \frac{\tan \beta + \tan \alpha}{1 - \tan \beta \tan \alpha} = \frac{3 \tan \alpha}{1 - 2 \tan^2 \alpha}.$$

This quadratic has only one positive root and so  $\alpha$  is determined.

In this solution leeway is not recognised, and the action of wind on a sail is treated really as the action of a smooth body, nevertheless this solution is much more complete than that given in the text of article XIV.

The real point discussed however in the text was the difference in direction between that of the wind as a mass of moving air particles and that of the driving force felt by the sail and thus by the ship.

The fact that the wind was virtually changed in direction through striking the sail obliquely was the main idea to be apprehended. The exact amount of weakening that the wind virtually experiences was immaterial to the argument. We were not comparing the old velocity which wind, striking a sail set square to the wind, would produce or tend to produce with the new velocity which the same natural wind would tend to produce when the sails were changed in direction. Thus the addition of this note in no way affects the argument in the text.

A. E.

#### NOTES FROM HOME.

(From our own Correspondent.)

The Annual Report of the Institution of Civil Engineers stated that during the last 12 months there had been an addition to the roll of 49 members, 183 associate members, the number of non-corporate associates being reduced by 23. The increase had been 1.6 per cent. per annum as compared with 4.19 per cent. for the previous 12 months. The total number now on the books was 5,530.

A paper was recently read on the Acton Main Drainage Works by Mr. Lailey before the Society of Engineers. This paper deals largely, and indeed specially, with the system of the International Purification Company, which Acton was the first town to adopt. The precipitating tanks are three in number, which will hold 138,000 gallons of sewage each. In addition to these there are two smaller tanks, one of which contains the magnetic spongy carbon filter bed. The magnetic process consists in precipitation of the solids, and in filtration of the effluent through a bed containing a layer of magnetic spongy

carbon. This magnetic carbon is a hard material possessing great oxydising and aerating properties. The precipitant used is a magnetic ferrous carbon and the mode of applying it is to grind it up into a thin slurry with water or sewage as it flows into the precipitating tanks. Here it settles for about three hours, and the effluent is then passed through the magnetic spongy carbon filter bed, from which it issues pure, and goes into the Thames. It is stated that nine months' experience have allowed the Acton Board to pronounce the system a success.

A new scheme has just been inaugurated for the supply of water for Southampton. It consists of a reservoir at Otterbourne, 200 feet above the sea-level, about four miles south of Winchester, and eight miles north-east of Southampton. The Act for these works was obtained in 1885, and the works were at once commenced. The Otterbourne Hill reservoir, and the pumping and gravitation mains, have cost just under £60,000. It appears that the Corporation of Southampton have, during the past four years, in connection with the perfecting and re-organizing of their water-works undertaking, laid down about 14 miles of new mains within the borough at a cost of £13,000. They have adopted Deacon's Waste Meter system at a cost of £2,600, and have initiated a new system for the supply of water for street watering and sanitary purposes.

Every now and then at long intervals something is heard of the Thirlmere Water-Works, shewing that some progress at any rate is being made. It is now nine years since the Act was obtained. Among the powers given was authority to raise the lake 50 feet by means of an embankment at the outlet. It is found now only necessary to raise the level of the lake by 20 feet, and instead of laying down 5 pipes, each of which was to convey 10 million gallons per day to Manchester, only one such pipe will be required. No opposition is expected to these amended powers asked for.

The new route to South-End, which was opened for traffic on the 1st of this month, materially reduces the distance between London and South-End. The management of the London and Tilbury Company has decided that all the express trains to South-End will run *via* the new route, performing the journey between London and South-End in from 45 to 50 minutes, as against an hour and a half hitherto occupied on the journey.

From an advertisement appearing in the *Times*, it appears that the Sanitary Institute, together with the Parke's Museum, seek to be licensed by the Board of Trade under the Companies' Act. It will be remembered that these bodies sometime back sought to obtain a Royal Charter, which from opposition offered from certain quarters was not granted by the Privy Council.

## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

Burma, June 30, 1888.

#### Upper Burma.

Mr. J. P. Henderson, Assistant Engineer, 1st grade, Meiktila Division, is granted one year's furlough with effect from the 22nd instant, or such subsequent date as he may avail himself of the same.

#### Lower Burma.

With reference to Burma Public Works Department Notification, dated the 6th instant, Major T. Gracey, R.E., Special Superintending Engineer and Secretary to the Chief Commissioner, Public Works Department, Upper Burma, handed over charge of the Public Works Department in that portion of the province to Lieutenant-Colonel W. G. Cumming, R.E., Chief Engineer and Secretary, on the afternoon of this date.

Major T. Gracey, R.E., Special Superintending Engineer, Upper Burma, is granted furlough to Europe to the 15th November 1889, together with the usual subsidiary leave, with effect from such date as he may avail himself of the same.

Mr. James Wallace, Assistant Engineer, 1st grade, Bhamo Division, is granted furlough to Europe for 15 months, together with the usual subsidiary leave, which he availed himself of on the afternoon of the 7th June 1888.

Hyderabad, July 2, 1888.

With reference to Government of India Public Works Department Notification, dated the 7th June 1888, Mr. H. F. Storey, Superintending Engineer, 2nd class, assumed charge of the office of Superintending Engineer and Secretary to Resident, Hyderabad



Public Works Department, from Mr. G. K. Watts, Assistant to Superintending Engineer and Assistant Secretary to Resident, on the forenoon of the 22nd instant.

#### Madras, July 3, 1888.

Mr. C. H. D. Marjoribanks, Assistant Engineer, 1st grade, is granted furlough on medical certificate for one year, with effect from 29th May 1888.

The following transfer is ordered :—

Mr. S. W. H. Ottmann, Sub-Engineer, 1st grade, and Honorary Assistant Engineer, 1st grade, from the III. Circle, Kurnool Division, to the V. Circle, Presidency Division. To join from privilege leave.

The following promotions and reversions are ordered :—

Mr. J. H. Medlicott, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 26th April 1888.

Mr. J. H. Medlicott, Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, permanent, with effect from 29th May 1888.

Mr. J. J. Whiteley, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 29th May 1888.

Mr. J. J. Whiteley, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, permanent, with effect from 8th June 1888.

#### Bombay, July 5, 1888.

##### Railway.

Furlough for fifteen months from such date as he may avail himself of it is granted to Mr. O. J. Shedlock, Executive Engineer, Bellary-Kistna State Railway.

His Excellency the Governor in Council is pleased to order the following promotions in the Engineering Establishment to fill vacancies :—

Mr. S. B. Doig, to Executive Engineer, 1st grade, permanent rank, with effect from 13th November 1887.

Mr. E. K. Reinold, to Executive Engineer, 2nd grade, permanent rank, with effect from 10th September 1887.

Mr. J. Young, to Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 10th September 1887, and permanent rank, with effect from 13th November 1887.

Mr. J. G. Single, to Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 13th November 1887.

Captain E. C. Spilsbury, R.E., to Executive Engineer, 3rd grade, permanent rank, with effect from 10th September 1887.

Mr. S. Rebsch, to Executive Engineer, 3rd grade, permanent rank, with effect from 13th November 1887.

Mr. G. O. W. Dunn, to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 10th September 1887.

Mr. E. Pinhey, to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 13th November 1887.

Rao Saheb G. R. Tiluck, to Executive Engineer, 4th grade, permanent rank, with effect from 13th November 1887.

Khan Saheb F. C. Tarapoorwalla, to Executive Engineer, 4th grade, permanent rank, with effect from 9th March 1888.

Mr. T. Summers, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 13th November 1887.

Mr. D. George, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 9th March 1888.

Mr. H. C. R. John, to Assistant Engineer, 1st grade, permanent rank, with effect from 21st November 1887.

Rai Saheb B. Chakrabati, to Assistant Engineer, 1st grade, permanent rank, with effect from 9th March 1888.

Rao Saheb Parashram Krishna Chitale to Assistant Engineer, 1st grade sub. *pro tem.*, with effect from 21st November 1887.

Mr. H. M. Thompson's promotion to rank of 1st grade Executive Engineer is antedated to 10th September 1887.

#### Punjab, July 5, 1888.

Mr. J. E. Hilton, Executive Engineer, Lahore Provincial Division will be placed, as a temporary arrangement, in current charge of the duties of the Superintendent of Works, III. Circle, in addition to his own, with effect from the date on which Lieutenant-Colonel E. Harvey, R.E., may proceed on privilege leave.

His Honor the Lieutenant-Governor has been pleased to sanction the promotion of Mr. F. W. Maunsell, Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from the 7th May 1888, *vice* Mr. Day, proceeded on furlough.

#### Central Provinces, July 7, 1888.

Three months' privilege leave is granted to Mr. G. M. Harriott, Executive Engineer, Kanhan Division, with effect from the 22nd instant, or any subsequent date on which he may avail himself of it.

#### India, July 7, 1888.

Mr. J. Cleburne, Executive Engineer, 3rd grade, North-Western Provinces and Oudh, is granted special leave for two years, under the terms of Public Works Department Notifications, dated the 3rd October 1887, with effect from 16th June, 1888.

With reference to Public Works Department Notification, dated the 4th July 1888, Major G. F. L. Marshall, R. E., is appointed Superintending Engineer and Secretary in the Public Works Department to the combined Administrations of Rajputana and Central India.

The Governor-General in Council is pleased to order the following temporary promotions to and in the classes of Chief and Superintending Engineers, with effect from the dates specified :—

Major J. W. Ottley, R.E., from Superintending Engineer, 3rd class, to Superintending Engineer, 2nd class, with effect from 1st January 1888.

Mr. F. E. Robertson, from Executive Engineer, 1st grade, to Superintending Engineer, 3rd class, with effect from 5th February 1888.

Mr. J. W. Wright, from Superintending Engineer, 2nd class, to Superintending Engineer, 1st class, with effect from 4th April 1888.

Mr. H. A. S. Fenner, from Superintending Engineer, 3rd class, to Superintending Engineer, 2nd class, with effect from 4th April 1888.

Mr. R. H. Rhind, from Superintending Engineer, 2nd class, to Superintending Engineer, 1st class, with effect from 13th April 1888.

Colonel G. E. L. S. Sanford, C.B., R.E., from Chief Engineer, 2nd class, to Chief Engineer, 1st class, with effect from 15th April 1888.

Mr. T. H. Wickes, from Superintending Engineer, 2nd class, to Superintending Engineer, 1st class, with effect from 25th April 1888.

Major W. L. Greenstreet, R.E., from Superintending Engineer, 3rd class, to Superintending Engineer, 2nd class, with effect from 25th April 1888.

Major G. Hildebrand, R.E., from Superintending Engineer, 3rd class, Supernumerary, to Superintending Engineer, 2nd class, Supernumerary, with effect from 25th April 1888.

Colonel B. Lovet, C.S.I., R.E., from Superintending Engineer, 2nd class, to Superintending Engineer, 1st class, with effect from 7th May 1888.

Brevet Lieutenant-Colonel W. G. Nicholson, R.E., from Superintending Engineer, 3rd class, to Superintending Engineer, 2nd class, with effect from 7th May 1888.

Major T. Gracey, R.E., from Superintending Engineer, 3rd class, to Superintending Engineer, 2nd class, with effect from 26th May 1888.

Mr. E. J. Martin, from Superintending Engineer, 1st class, to Chief Engineer, 3rd class, with effect from 2nd June 1888.

Mr. F. J. J. Johnstone from Superintending Engineer, 1st class, to Chief Engineer, 3rd class, with effect from 2nd June 1888.

##### Military Works Department.

Lieutenant H. C. Nanton, R.E., temporary Assistant Engineer, 2nd grade, is appointed to the current duties of the Office of the Executive Engineer, Allahabad Division, Military Works, in addition to his own duties, during the absence of Captain T. Digby, R.E., Executive Engineer, on privilege leave, with effect from the forenoon of 21st May 1888.

#### Bengal, July 11 1888.

##### Establishment—Irrigation.

Mr. T. M. L. Thomson, Executive Engineer, Northern Drainage and Embankment Division, is granted privilege leave for three months, with effect from the 6th of August.

Mr. R. E. Carter, Assistant Engineer, is appointed to be Executive Engineer of the Northern Drainage and Embankment Division, during the absence on leave, of Mr. Thompson, or until further orders.

##### Establishment—General.

Mr. J. C. White, Executive Engineer of the Kalimpong Division, is, on the abolition of that Division, from the 20th instant, appointed to be Executive Engineer of the Darjeeling Division.

Mr. W. H. Nightingale, Inspector of Local Works in the Bhagulpore Division, having returned to duty on the 4th instant, the unexpired portion (two days) of the privilege leave granted in Government Notification of the 4th May last is cancelled.

Lieutenant-Colonel C. W. I. Harrison, R.E., Officiating Chief Engineer and Joint-Secretary to Government, officiated as Secretary to Government, in addition to his own duties, from the 15th April to the 1st June 1888, both days inclusive.

## Advertisements.

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A DRAFTSMAN and Estimator. Must be able to finish drawings from pencil sketches. Pay up to Rs. 90 according to qualifications

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Full particulars on application to the Controller of Stores, E. I. Railway, Fairlie Place, Calcutta.

**D. W. CAMPBELL,**  
AGENT.

CALCUTTA, 12th July 1888.

**PUBLIC WORKS DEPARTMENT.**  
NOTIFICATION.**S**EALD Tenders are invited in the P. W. Department Form No 7M for constructing two wrought-iron caissons, required for closing Chitpore Lock. Amount of Estimate Rs. 28,670.

Drawings, specifications, and estimated quantities may be seen at the Office of the Executive Engineer, Circular and Eastern Canals Division, where forms of tender and other information can be obtained.

Tenders, which must include fitting and delivery of the caissons at Chitpore Lock, will be received up to noon of 23rd July. Earnest money to the amount of Rs. 700 in currency notes must accompany each tender.

The right of rejecting all or any tenders is reserved.

**G. SHAW,**  
EXECUTIVE ENGINEER,  
Circular & Eastern Canals Divn.**BEST MIRZAPUR STONE.**

The Mirzapur Stone and Trading Co., Cut-Stone Contractors and Quarrymen, Manufacturers supply.

Paving .. .. Roofing.  
Pillar Bases .. .. Coping.Also a description of Cut Stone. The cheapest in the market.  
Apply to the Company or to**LYALL, MARSHALL & CO.,**

4, Chit Ghat Street, CALCUTTA.

(15) Depot—Sulkea, Calcutta.

**WANTED.****A** GOOD Estimator, Salary Rs. 100, and a good Draftsman, Salary Rs 60 rising to Rs. 75. Apply with copies of testimonials to—**H. F. WHITE, M.I.C.E.,**  
Superintending Engineer,  
(153) 1ST CIRCLE, RANGOON.**NOTICE.****W**ANTED, a SECRETARY for the Municipal Board of Sholapur. Candidates are invited to send applications, specifying full Name and Age, to Undersigned, before 20th of July next. Examination Certificates and Testimonials should accompany. Good knowledge of English and Marathi and, if possible, knowledge of Accounts, aptitude for active and administrative duties, Professional Engineering, actual experience of Municipal or other administrative work, are the expected qualifications.

The permanent incumbent of the post is on leave without pay, which expires on the 1st of May, 1889, and is at present employed as Secretary to the Surat Municipality, and stands a fair chance of being confirmed there. The Municipality does not hereby bind itself to confer the vacancy upon the best or any of the candidates.

**HIRACHUND NEMCHUND, Chairman,****SHOLAPUR MUNICIPAL OFFICE,**  
(156) 21st June 1888.**Managing Committee,**  
**SHOLAPUR MUNICIPALITY.****NOTICE.****T**ENDERS for the purchase of the Burma Government S.S. "Palakwa" will be received by the Deputy Director of the Indian Marine up to gunfire of Monday, the 16th July 1888.

2. The Vessel will be sold at Calcutta with engines, boilers, masts, sails, awnings, spars, anchors, cables, boats, and such other stores as may be on board now and which will not be removed previous to the sale.

3. Each tender, before being opened, must be accompanied by a treasury receipt for a sum equal to 25 per cent. of the amount offered, and the balance must be paid within 48 hours of acceptance of the tender and before delivery is taken. The tenders will be submitted to the Government of Burma for orders.

4. The Vessel will be at the risk and charge of the purchaser from the date the acceptance of the tender by Government is communicated to him.

5. The following description of the Vessel is believed to be correct, but any errors or misdescription shall not annul the sale, nor shall any compensation be allowed on that account :—

		Ft.	In.
Length, extreme	...	120	0
Between perpendiculars	...	116	0
Breadth, extreme	...	27	6
" moulded	...	16	0
Depth	...	6	0
Hull, material built of	...	Iron.	
Where built	...	Govt. Dockyard, Kidderpore.	
When built	...	1882.	
Engines, description of	...	Comp. Diagonal non-condensing paddle.	
Where built	...	Govt. Dockyard, Kidderpore.	
When "	...	1882.	
Cylinders	...	20" & 36½"	
Stroke	...	30"	
N. H.-P.	...	57	
I. H.-P.	...	183	
Speed	...	10 miles.	
Consumption of Coal	...	4cwts. per hour.	
Tonnage, R. O. M.	...	144 tons.	

6. The Vessel is open for inspection at the mornings off the Government Dockyard, Kidderpore, on applying for an order to the Deputy Director of Indian Marine.

7. The undersigned does not bind himself to accept the lowest or any tender.

**H. M. I. M. DOCKYARD,** (SD.) **A. GWYN Capt.,**  
(156) KIDDERPORE. *Offy. Dy. Director, Indian Marine.*

These wheels are Noiseless and self-lubricating, do not drop oil or allow the rope to be pulled off them, are easily fixed in any position, answer equally well as Vertical or Horizontal wheels, and run perfectly for years without attention.

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New and improved pattern, equally suitable for use in Chartered Hospitals and Public buildings as in Private Houses.



**AUCTION SALE OF****Freehold Land, Dwelling House, Unfinished Graving Dock, Wharf, Sheds, Barracks, Out-offices, &c., in Rangoon.**

The undersigned have been favored with instructions from the Executrix to the Estate of the late

**Mr. J. MACRORY, to Sell by Public Auction on an early Date***The whole of the valuable Landed Property belonging to the above Estate,***SITUATED AT DUNNEEDAW, RANGOON,**

COMPRISING

1. A portion of Suburban allotment Lot No. 17 measuring 200 by 800 feet with an unfinished Dock measuring 420 by 56 feet and 4 inches with 2 gates, each gate 30 feet by 9 inches wide.
2. A Wharf complete measuring 150 by 18 feet leading to the above.
3. Workshop sheds built of galvanized roof and walls measuring 240 by 40 feet.
4. The substantially built dwelling house 46 by 46 feet with a portico 16 by 16 feet and out-houses complete.
5. The Office and Blacksmith's Shops complete with tools, 86 by 20 feet, with galvanized iron roof.
6. Workmen's dwelling 180 by 26 feet with galvanized iron roof.

Government sanction having been obtained for constructing the dock, it affords a splendid opportunity to Capitalists to invest their money for profitable returns.

The want of a dock for a rising place like Rangoon has long been felt, which the late Mr. Macrory endeavoured to supply, but was prevented by his sudden demise, in consequence of which the above property is now offered for sale.

TERMS—A deposit of 25 per cent. to be paid on the day of sale, and the balance within one month from date of sale.

The property to be at purchaser's risk from the time of sale.

All transfer charges to be borne by the purchaser.

Note—Private offers will be received up to two days before the sale. Any information required by intending purchasers will gladly be given by

**RANGOON.****BALTHAZAR & SON,****AUCTIONEERS.**

(2778)

**P. W. D., AKRA DIVISION.****NOTIFICATION.**

Tenders for the supply of coal for Brick burning will be received by the Superintendent, Akra-Factory, up to noon of Monday, the 23rd July 1888.

The probable quantity of coal required is about 500 tons of Rubble and about 15,000 tons of dust coal, and no tender will be considered for the supply of quantities less than one half of the above.

Tenders are to be made in P. W. D. Form No. 14M. and Rs. 200 is to be submitted with each tender as earnest money.

Tenders should specify (1) the rate per ton at which the coal will be delivered into E. I. R. waggon at the Pit mouth or at the nearest Railway siding to the Pit; (2) the rate at which despatches can be made per week after the 1st November; and (3) the name of the Pit from which the coal is arised.

For further particulars apply to the Superintendent, Akra Factory.

**S. C. GHOSE, RAI BAHADOOR,**

AKRA,

Superintendent,

The 28th June 1888.

AKRA BRICK FACTORY DN.

(152)

**ICE! ICE!! ICE!!!****FOR SALE.**

**THREE** Ammonia Machines, Carrés system, 2 of 1 ton each, 1 of  $\frac{1}{2}$  ton capacity with Steam Engine, Boiler and Ammonia Still. The whole for cash. The above are second-hand having been at work 4 or 5 years. For further particulars apply to

**P. C. RUBIE,**

LUCKNOW;

16th June 1888.

(141)

P.-ATTY. TO LIQUIDATORS,

General Ice Factory Co, Ltd.

**WANTED.**

**A**N Overseer for the District Board, Patna, for 18 months certain, @ Rs. 90 per mensem, including allowances.

Applications with copies of Testimonials should reach this office not later than the 15th July 1888. None need apply who has not had experience of road and bridge works, and had not served in the P. W. D. as a 3rd grade overseer for more than five years.

By Order,

**POORNA CHUNDR CHATTERJEE,**

ACCOUNTANT,

For Offg. District Engineer,

Patna.

(146)

**IRON WIRE FENCING,**

SPECIALLY ADAPTED FOR

**INDIA AND THE COLONIES.****GEORGE'S PATENT TUBULAR IRON WIRE FENCING,**

SPECIALLY DESIGNED FOR ENCLOSING RAILWAYS, ROADS, BUNGALOW GROUNDS, PLANTATIONS, &amp;c.

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**L**ARGELY used by the Indian State and Guaranteed Railways, combines Strength, Lightness, and Low Cost. Any smart native can erect it. Cost of transport per mile of Railway only about 3 annas per mile of Fence. **Fencing Posts.** Straining Posts, Galvanized Steel, Strand Wire, Galvanized Steel Barb Wire, Wrought-iron Gates of all sizes with Posts, complete, suitable for Railway Level Crossings, Plantations, Bungalow Grounds, &c. A complete Fence with Barb, Strand or Steel Wire, suitable for a plot of ground of any shape, or for a length of Road or Railway supplied ready for fixing.

Delivery given at any RAILWAY STATION in India.

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(36)

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Premiums after deducting	
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Interest	£ 19,612 0 0
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Re-insurances	£125,559 0 0
Interest and Dividends	£ 45,649 0 0
Claims less Re-insurances	£ 79,229 0 0

### MARINE DEPARTMENT.

Premiums after deducting	
Re-insurances	£175,118 0 0
Interest	£ 8,294 0 0
Losses after deducting Re-insurances	£138,365 0 0
Interest not belonging to above, but included in Profit and Loss	£ 18,545 0 0

**The Life Fund was increased during the year by £65,648 and now amounts to £1,070,064.**

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the uncalled Capital of £2,250,000.

The rates of Premium are moderate, but they are not unsafely low, and will be found to stand the test of time, thereby in conjunction with the ample Funds affording absolute security to the assured.

The Total Funds and property in hand on 31st December 1887 stood at £2,613,059.

(39)

**C. H. OGBOURNE, Manager and Underwriter.**

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(29)

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MACHINERY CYLINDER ENGINE OIL SPINDLE BATCHING LUBRICATING

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PATENT SUGARCANE MILLS.

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(103)

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TRADE MARK.  
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Sole Agents for Bengal.

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Specially Appointed by the Royal Commission for the  
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Not a single case of illness occurred amongst the Native  
Artisans employed in the Exhibition owing to their  
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## JEYES' SANITARY COMPOUNDS.

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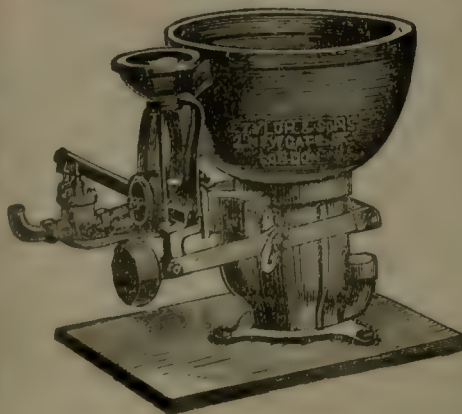
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SOLE AGENTS, Calcutta.

## Calcutta Plumbing & Gas Fitting Establishment.



Materials of all  
sorts for the  
above always  
in stock. Trade  
supplied on  
the usual  
terms.

J. D. JONES,  
Mechanical Engineer,  
PROPRIETOR.

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# Notices.

The Office of Publication of Indian Engineering is at the "STAR PRESS," 19, Lall Bazar, Calcutta.

General correspondence, and all communications bearing upon literary matters, should, as heretofore, be addressed to PAT. DOYLE, C.E., Spence's Hotel, Calcutta.

It is particularly requested that all letters on business concerning subscriptions and advertisements be addressed to the "Managing Agents," MESSRS. BALMER, LAWRIE & Co., 103, Clive Street, Calcutta; and all remittances be made payable to them.

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## NOW READY.

# "Artesian Borings in the Sunderbunds."

As the issues of the journal containing the articles headed as above are out of print, and sufficient inducement having offered, the matter has been reproduced in pamphlet form to meet the requirements of District Officers and others in Bengal and elsewhere.

Price Rs. 2 per copy.—Cash.

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# INDIAN ENGINEERING.

SATURDAY, JULY 21, 1888.

## THE PUBLIC SERVICE COMMISSION.

WE commend to the notice of the Heads of the Indian Engineering Colleges that part of the article on the Public Service Commission in the *Pioneer* of 19th June which refers to the P. W. D. in the following terms:—"But the Engineers might ask, why should not a Cooper's Hill man continue to make bricks for fifteen years? He probably makes them better now than when he began. Granted that he is paid somewhat more than the indigenous outcome of Roorkee, is it not truer economy to be sure of good bricks and good mortar in buildings and bridges, than to have them tumbling down in a year or two? Cooper's Hill was founded to put a stop to the want of education, the bad work, the waste of material, and the corruption that reigned in the Public Works Department throughout India. It is conceivable that times have so changed that a competent and honest agency is to be locally obtained through the Indian Engineering Colleges. But there is nothing in the Commission's Report to satisfy us that this is so, and their recommendations have simply the effect of inducing us to suspend judgment until we hear what the professional critics and the experts have to say."

Now, as professional critics, we have no hesitation in saying that the work demanded from fully 75 per cent. of the P. W. D. requires absolutely no Engineering knowledge of a high order, but simply a practical acquaintance with materials, rates and men, business habits and an iron constitution. Honesty of course.

Not only are these higher attainments not required, but most of those originally possessing them have lost them from disuse, after a few years' practical work.

The average P. W. D. Engineer, to keep up his scientific attainments, must study apart from his work, if he can find time to do so.

The Roorkee man can make bricks just as well as the Cooper's Hill man in 90 per cent. of the places to be filled; what a pity then he should be corrupt!

So far as the purely theoretical part of the training is concerned, it would take a good deal of proof to shew that the knowledge of a passed Engineer student of an Indian College is not sufficient for any work in the ordinary run of the P. W. D., and therefore for that purpose fully equal to the superior attainments of Cooper's Hill, before they have faded away.

So far as the practical part is concerned, the passed students of Cooper's Hill and Roorkee stand on precisely the same platform, they neither have any practical knowledge.

The few Cooper's Hill men who are reserved for the "practical course" in England fall into the category of Engineers who might be supplied from other sources. There is no inherent improbability in a Roorkee student, after a training in England under the new rules, equaling a Cooper's man.



On the whole, as professional critics, we can endorse the recommendation of the Commission to depend more upon local resources, but we go beyond them, and say that should Cooper's Hill be abolished, Engineers of higher attainments than can be provided from Roorkee, can be found among the R. E.'s who could always be utilised in the P. W. D., under the rational system prevailing in other countries, while C. E.'s could be obtained in the open market.

It is preposterous to assert that the ordinary laws of supply and demand are unequal to providing sufficient Engineering talent for the Indian Government. The history of Engineering enterprise radiating from England and of the work done in India itself by other than Government Engineers, and by Government Engineers obtained in the open market, gives the lie to such a proposition. It was not believed by the Government of India itself, and was derided in England, when Cooper's Hill was started.

It is true that Cooper's Hill is an excellent—and we are disposed to say the best—institution for providing as good an Engineering education as can be obtained in a College, but there are others in England, and so far from being a College absolutely necessary to train Indian Engineers, it is now simply competing with self-supporting institutions to train Engineers for the general market. The question is, therefore, no longer whether it is impossible to get Engineers in England, but whether the Secretary of State is justified in spending the money of the Indian tax-payer any longer to train Engineers for India.

Perhaps it is not generally known that, although the fees of Cooper's Hill are placed about as high as possible, yet the institution was worked at a loss.

So much for the general aspect of the question, but the extract with which we commenced demands some notice.

The Duke of Argyll, for a much milder statement in reference to this very matter, had to eat his words. The writer must either be absolutely ignorant of the facts on which he presumes to advise the Commission, or must have some private interest to serve in bolstering up Cooper's Hill at any price.

We presume, when he accuses the P. W. D. Engineers in forcible terms of incompetence and corruption, he does not include the Military men, who then formed the bulk of the Department, but refers only to the Indian men and the Stanley men. Now, we do not remember a single witness before the Commission so much as hinting at either of those classes being generally incompetent or corrupt, and we think we may safely leave such a monstrous accusation to the sense of our readers without any further remark.

It would be interesting to have the opinions of the Heads of the Indian Colleges as to whether they would not supply a few competent and *honest* Engineers yearly.

We rather think that Military Engineers were principally concerned in most of the failures of barracks that have made a noise in the P. W. D.; and for a nice sense of honor and competent business qualities among

high Indian officials, we should like our contemporary to produce an instance from the despised Engineers to match the present Hyderabad scandal.

### THE UNCOVENANTED SERVICE.

ALTHOUGH the cause of the uncovenanted service received a temporary check in the House of Commons, it was certainly not owing to want of advocacy. In fact, it is a hopeful sign of the times that such an interest is being taken on a subject which a decade ago would not perhaps have been permitted a hearing by that august assembly. To say the least about Mr. King's speech, it was marked by an originality of conception and a breadth of view which do honour to the head and heart of the speaker, to say nothing of the eloquence which distinguishes the address above all others that were delivered on the occasion. Let the members of the service take heart that the thin end of the wedge has been inserted, and the favourable decision of the question is only a matter of time. Now that the public at home have come to know how the land lies with those who are not so fortunate as to leave the shores of England for India armed with a covenant, some sympathy will be extended to those useful adjuncts of British administration in the East.

It would be beside our purpose to review at length the entire speech of Mr. King extending over columns of closely printed matter, but it would be as well if the attention of the public in this country should be drawn to some of the more salient points in the arguments employed by him, which were simply unanswerable, and recourse was had to swamp the motion by a sheer majority of votes, most of those voting perhaps did not understand what the drift of Mr. King's contention was, but merely followed their leader—the blind leading the blind. How truly did he observe: "The subject may be an uninteresting one to many members, but I hardly think it can fail to attract attention when I tell the House that this is the cry of the whole service, not the mere fad of an individual or of disappointed men, not of a few men in the service who have combined together to bring up some fancied grievance. I speak as spokesman of the whole service, from highest to lowest."

Of the reasons given by that gentleman, why there has been such luke-warmness displayed by the English Government in connection with this affair, there is none which was such a decided thrust home as the explanation that no uncovenanted servant has ever entered the sacred precincts of the India Council. If such a concession had been made, we would not have been subjected to the humiliating spectacle of seeing the House of Commons pooh-poohing such a grave question as the future well-being of one of the most enlightened services in the world. While Civilians and Military men, lawyers and merchants, the latter having no hand in the administration of this country, are permitted a seat in the India Council, the uncovenanted service has been carefully excluded from it, as if they were an inferior set of men whose presence there would mar the harmony of its proceedings. This exclusion has a great deal to answer



for the present miserable condition of that service. Mr. King's remark on the uselessness of the institution is so much to the point that we will quote it here even at the risk of being considered prolix:

The system of dual government has often been tried, and has rarely been a success. (Hear, hear.) In the case you hardly ever know whom you have to approach. We have a figure-head—the Secretary of State. We have an Under-Secretary of State, but if you really look into the matter deeply you will find that the people who have the real power are the fifteen who draw £1,200 a year each from the revenues of India—(ironical Radical cheers)—the irresponsible gentlemen who form what is called the Council of the Secretary for India. (Hear, hear, and laughter.) I hope it may not be many years before the House will come to the same opinion that I have come to—that the Council at the present day is an anachronism." It must have surprised a great many of the honorable gentlemen present in the House to learn from what small beginnings the uncovenanted service have risen to be "one of the most useful, efficient and hard-working bodies of men in the service of any State!" It has given birth to a Kellner, a Croft, a Kavanagh, a Forjett and a host of others too numerous to mention, of whom any country would be proud. And these are the representative men who are denied a rational request that their grievances might be enquired into by a Select Committee of the House, even when the government of Lord Dufferin had no objection to the adoption of such a course.

Mr. King shewed in the plainest manner that owing to the shifting character of the Civil Leave and Pension Code, great hardships were entailed upon that body, and more so upon its senior members. By recent arrangements it has come to pass that juniors absolutely enjoy greater advantages in these matters than those under whom they work. As an example he cited the case of the head of the Engineering Department, Bengal, who had four or five juniors who are better off than he is, inasmuch as they are entitled to more privileges under leave rules. This is an anomaly which the House did not seem to comprehend. But this is not all. While some of them have become entitled to the enjoyment of the privileges granted to all in Schedule A of the Code, by a curious interpretation of the rules they are not allowed to participate in the benefits.

These grievances affected the majority of the members, but the question of the rate at which pensions of retired officials are drawn in England affects the whole body and is one of very serious import, connected as it is with the ultimate efficiency of the service, and which cannot but be productive of widespread dissatisfaction, and the effect it would have on the working of the administration. We have on several occasions referred to this subject of pension drawn in England at a ruinous loss. The injustice lies in the fact that nearly thirty years ago when the rupee was equivalent to 2s. 2d. with the prospect of rising to 2s. 4d. and 2s. 6d., the maximum pension was fixed at £500, considering that to be an equitable amount, but the present amount by continual

depression represents a fraction of that sum. And yet this miserable pittance is considered by an enlightened Government to be a sufficient recompense for thirty-five years' work in a deleterious climate like that of India.

With regard to the poverty of the finances which is put forward as necessitating these cheese-paring proceedings, Mr. King gave an apt illustration of how public money was being squandered, viz.: the cost of the Town Hall at Simla, the estimate of which rose from two lakhs to four lakhs, and yet we believe there is the usual cry of the daughter of the horse leech "More, More." The mischief directly arising from the depreciated payment of pensions year after year, is one of those factors in a consideration of the question which ought not to be lost sight of. Servants who have passed that age when they could efficiently serve the Government, linger still on in the hope of laying by a little more accumulation, and thus are a stumbling block in the way of those who have patiently waited for promotion and see it as far off as ever. This naturally causes heart-burn in the service, and friction is the result. How far this is conducive to a healthy administration of the country, we would leave our readers to judge for themselves.

The members of the uncovenanted service must not be down-hearted. One swallow does not make a summer. Mr. King's defeat is only a temporary reverse. From what we can learn of him by his speech on the occasion, he is not the man to tamely submit to such an iniquitous judgment. He will probably come to the charge again when Englishmen at home come to be more enlightened on Indian subjects, and we trust the day is not far off when justice will be meted out to a most deserving class of public servants. We hope to refer to this subject in a future issue.

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## A SUGGESTION.

### II.

MAJOR J. B. KEITH, the late Archæological Surveyor of N.-W. P., who, though not an Engineer by profession, had been engaged in the repair of some old monuments in Rajputana and Gwalior, and is favorably known by his carved Indian gateway in the Calcutta Exhibition, writing a short time ago from Malta to the *Pioneer*, gives the solution when he says that it has been made into a sort of close preserve by an interested ring of antiquarians. Mr. Melik Beglar also distinctly hints at some such combination when he says, that he should be simply perpetuating the vicious mystery with which Indian archæological research is shrouded by the numismatic prolix uncertainty and paleographic intricacy of some archæologists, or by the unfruitful critical verbosity on monumental architecture of others, were he to pass over certain researches with a bare allusion and a bald statement which few experts would contradict, and fewer outsiders understand or attack; and he goes on to add that, he feels that an undesirable mystery has somehow or other been instrumental in prolonging his apprentice-



ship to this fascinating science to fifteen years, when every other science or art needs but an apprenticeship of five to ten years.

That there is some truth in the independent testimony of two officers of the department, both favorably known to the public, for Mr. Melik Begar's reports, when serving under Sir A. Cunningham, have been before the public in the volumes of the Archaeological Survey of India, edited by Cunningham, and have never been adversely criticised, appears difficult to doubt. An examination of the *personal* of the department, so far as outsiders may judge from it, tends to confirm the charge brought by Major Keith, for with the exception of the Director-General whose volumes have never, we believe, been reviewed, of Mr. Melik Begar already alluded to, and Mr. H. B. W. Gairdner, whose writings, however, were some time ago subjected to rather a severe criticism in the *Pioneer*, not one of the other officers appear to have produced anything in the nature of a report to which the public have access on any monument in India.

But a Government which is casting about for reductions wherever possible, can scarcely permit an interested or uninterested ring of any sort to make a close preserve of a whole department. How much relief can be afforded to the congested P. W. Department by the throwing open of this apparently close preserve will be evident when we point out that by a Government resolution each Provincial Government was furnished with a Surveyor and an Assistant Surveyor. In the five Governments of Madras, Bombay, Bengal, N. W. P. and Panjab consequently there must be therefore ten appointments which can be filled, and properly and advantageously filled, by Engineers, to say nothing of the quite small army of draftsmen and measurers for whom useful employment may be found should a congestion be found to exist in these classes of subordinates in the Public Works Department. Five Executive Engineers and five Assistant Engineers can thus be placed in employments where they will not only be no burden to a Government bent on reduction, but where, if only care be taken to select the men who have a taste that way, they will do credit to themselves and to the department. In short, we would seriously suggest the incorporation of the department with the ordinary Public Works Department.

It may be objected to this that we have completely left out a most important consideration. The providing of officers who are experts in historical *archæology*, but this is easily provided for by retaining the present Director-General as long as his age permits him to serve in the status of a Superintending Engineer, but with his full present salary, subject, as all other Superintending Engineers are, to the P. W. Secretary; while with his retirement, the post may, on a *reduced salary*, be offered either to Major Cole, who, we remember, was some years ago the Government Curator of Ancient Monuments, or to Mr. Melik Begar, who had already put in it seems, when he wrote his report, sixteen years of "apprenticeship" to the science, and whose report certainly shews that in the matter of the *archæology*, at least of Bengal, he is as well

informed as, and a great deal more lucid, than, any writer whose works are before the public.

This arrangement would not only provide ten clear appointments for the relief of a congested service to the manifest advantage of both the services and of the men, but would provide a legitimate reward, in the last mentioned appointment, to such one of them as most effectually and zealously mastered the *archæological* mysteries of the service in which he was employed.

Of course it goes without saying that it may not be found desirable to dispense with the services of all the present incumbents, and it is further obvious that those who are got rid of, will have to be compensated in one shape or another, but, notwithstanding these, this department, which really ought to form part of the Public Works Department, should by some arrangement be brought within its pale, to the manifest advantage of both departments, and a clear saving to Government.

## TIDAL OPERATIONS IN INDIA.

### IV.

THE great practical use to which the observations are put is in the construction of the "Tide Tables for Indian Ports". These tables are published yearly, and give the times and heights of high and low water for each day of the year at all the stations on the coast where tidal observations have been taken. The predictions are made by mechanical means by the aid of the "Indian Tide Predictor," a machine by which the curves representing the different tides are all added together, the result being the predicted tidal curve. A crank on the machine is supplied for each tide used, and the amplitude  $R$  and the epoch on the first day of the year give the proper throw of the crank, and the angle at which it should be set so as to give the curve representing the tide. The machine is adapted so as to include the effects of 18 short period tides, and 2 long period ones; the tides considered of most importance when the machine was constructed.

This is the method of predicting the heights of the tide at open coast stations, but it was found to be unsuitable for riverain stations, owing to the large errors which were introduced by freshets coming down the rivers. On this account the observations at riverain stations are reduced separately for each month of the year, and the semi-monthly curves representing the tide obtained from the means of the corresponding months throughout the total period during which the observations have been taken.

The actual heights of the tide are carefully compared with the predictions with a view to improve the latter, and as the stations are closed, a graduated staff is set up at each so as to give the actual heights for this comparison.

Up to the present the corrections found from the meteorological observations have been applied only to the stations in the Gulf of Cutch; but for the practical object of predicting the heights of the tides for the Tide Tables, as the meteorological conditions must enter into the heights, the method of including them in the tides cannot produce any great error.



The peculiarities in the behaviour of the tide at some of the stations are very marked. For instance, at Aden about the times of the moon's quarters there is frequently only one high and one low water in the 24 hours. At Bhavnagar, the water rises gradually to high water where a long pause of about an hour and 20 minutes occurs, after which the water sinks more rapidly than it rose. The top of the tidal curve is very level throughout the pause, and the water is practically at the same level for 40 minutes before, and 40 minutes after high water. At Mormagao, Karwar, Colombo and Galle there is a curious vibratory action of the tide which causes the tidal curve to present a jagged appearance; or, in other words, the tide on its upward course rises, then falls a little, then rises again, and so on, and the same process is reversed in a falling tide. It is not due to lumpy water, as it is sometimes more evident when the water is apparently smooth. At Colombo, Galle and Pamben the height of the tide is in general considerably lower during the half of the year, in which the south-west monsoon occurs, than it is in the other half, and is lowest in the middle of the monsoon. At Kidderpore and Rangoon the times of change of current from ebb to flow and *vice versa* do not correspond to low and high water. At Kidderpore the tide runs up the river for about an hour after high water, and down for about the same time after low water, and at Rangoon it runs up for about an hour and 10 minutes after high water, and down for 30 minutes after low water. At Moulmein, the water at the jetty, when the observations were taken, although rising higher at springs than at neaps, falls lower at neaps than at springs. The greatest ranges in the heights of the tide occur at Bhavnagar and Amherst, where there is 33 feet and 20 feet respectively between high and low water, and the lowest occurs in Ceylon, the range being only about 2 feet. Considering the very exposed sites of some of the observatories, there have been very few accidents since the beginning of the operations. On 22nd September 1885, the storm wave caused by the cyclone which passed over False Point was most disastrous, and not only the observatory, with all the instruments, but the whole village of Hookey Tollah, was swept away. On 29th September 1886, the observatory at Dublat with all the instruments was carried away by a heavy wind and sea, and nothing was recovered.

The tidal diagrams from time to time are found useful to the meteorologist inasmuch as the effects of earthquakes and cyclones are graphically registered on them: in the case of the eruption of Krakatoa these registrations were of great assistance in tracing the course and velocity of the wave caused by it.

Such is a brief account of the tidal observations and their reduction: further information on the practical and theoretical parts of the subject will be found respectively in "A Manual of Tidal Observations" by Major A. W. Baird, R.E., F.R.S., and "A Report of a Committee for the Harmonic Analysis of Tidal Observations" by Professor G. H. Darwin, F.R.S., &c., 1883, both of which pamphlets have been used in compiling this notice.

## Notes and Comments.

**WONDERFUL.**—Madras covers an area of 20 odd square miles, and the Municipal expenditure on the up-keep of its roads is only Rs. 1,25,000 per annum.

**BURMA BUILDING ASSOCIATION.**—At a meeting of the Directors of this Association, held at Rangoon on the 7th June 1888, a dividend of 10½ per cent. was declared. We congratulate the shareholders and the management.

**MR. A. W. CRAWFORD, SUPERVISOR, P. W. D.**—Some time ago this man was imprisoned on an alleged offence of getting up a conspiracy to murder his Executive Engineer at Shwebo in Upper Burma. We are glad to learn that Mr. Crawford has been exonerated by being reinstated in his appointment.

**REDUCTIONS IN P. W. D. AND STATE RAILWAY ESTABLISHMENTS.**—We are glad to notice that the Government of India has accepted a suggestion that appeared in our columns for getting rid of its most inefficient and useless officers now employed on its public works and Railways, and has taken steps to carry it out.

**THE DONDRA HEAD LIGHTHOUSE.**—The lighthouse at Dondra Head is fast approaching completion. It is already six fathoms high, and has its foundation on solid granite. The place commands a grand scenery with the sea on all three sides stretching far and wide, and on the other side, the house of the Engineer and other cottages. The new road has a very picturesque appearance.

**RAILROAD LOCATION—FIELD PRACTICE IN THE WEST.**—To know what location is best for a railroad is one thing; to be able to make that location is another, and a very different thing. In other words, it is one thing to be a good locating Engineer; it is another thing to be a good chief of a locating party. To be the one does not imply that you are therefore the other, even in point of knowledge.

**DURBAR HALL FOR MYSORE.**—We understand it is in contemplation to erect a Durbar Hall for public purposes at the capital of Mysore. A design for such a building is now in hand, and it is likely the work will be commenced as soon as the plans are matured and the locality selected. The Durbar Hall will be a grand building, worthy of the Mysore State; its main Hall will be about 130 feet long. A grand dome, rising to a very good height, will crown the centre room.

**THE "SILVER" QUESTION.**—At the late coming together of the Chicago Convention rehabilitation of silver was voted one of the main planks of the Republican platform. We are not told how the miracle is to be effected. Meanwhile, Californian and other mines in the States are reported to be turning out large quantities of silver. Such a yield most assuredly does not make for rehabilitation, but contrariwise. India's best hope for the rehabilitation of silver lies in persistent agitation for reduction of the Home charges, in strict administrative economy and development of the Railway system, with view to increase of exports.

**ENGINEERS IN THE NAVY.**—A correspondent writes:—The Admiralty have issued new regulations with regard to provision of cabins for senior Engineers, and have directed that accommodation shall be provided for them as near the engine-room as practicable. It seems that the senior Engineers themselves asked for this disposition of cabin accommodation. Afloat or ashore it is a characteristic of Engineers always to subordinate their own



comfort and convenience to the interests of the work they are set to do, and take pride in doing with watchful completeness. The profession at large has a fair title to feel proud thereof. *Ergo* this "Note"—of admiration.

**WORKING OF THE INDIAN FACTORIES ACT OF 1881 IN SOUTHERN INDIA.**—We have before us fifteen pages quarto of official correspondence, and report on the employment of juvenile labor in Madras factories, and the amount of whitewash expended on factory walls and belongings. The Inspectors found no children less than twelve years of age employed, saw that "all the requisite notices were hung up conspicuously," and reported the factories clean, and well ventilated. *Voilà tout*. We should like to know what it has cost the Madras Government to give this information to the wide world—what is the amount of its printing bill for diffusion of this useless knowledge.

**RAILWAYS IN THE PHILIPPINE ISLANDS.**—Consul Gollan, of Manila, reports that very little progress has been made with a railway between Manila and Dagupan, the concession for which was granted to an English company under a Government guarantee of 8 per cent. The prospectus of another line, the Centre of Luzon Railway, has been issued. The length of the proposed railway is  $23\frac{1}{2}$  miles, and its course, in the immediate vicinity of Manila, would be through so populous and fertile a district, that no guarantee on capital is asked for from the Government, as it is thought that the traffic will prove sufficient to give a handsome return on the outlay. The required capital is estimated at £225,000.

**ROSE FARMING AND ITS PROFITS.**—Here are some notes by an expert on the subject of rose farming and its profits. The Bussorah brand has the best name in the scent market. Red roses are ranker and better than white. On an average ten pounds of fresh red rose petals yield, on distillation, a gallon of superior rose water. Retail price of it Re. 1-8-0 per pint. Pure attar of roses fetches £10 per tolah. In the Ghazeepore district there is a rose garden, some 150 bighas in extent, which for some years past has yielded an annual income to its proprietors averaging Rs. 40,000. The Bulgarians go in largely for rose cultivation, and put from three to four thousand pounds weight of attar on the London market every season.

**HOME PURCHASES OF GOVERNMENT SUPPLIES.**—During the year under report, a total sum of £896,590 was expended on State Railway stores contracted for in England, while Rs. 11,73,000 were spent on State Railway stores purchased locally. The material brought from England was chiefly permanent way (£365,543), locomotive and rolling-stock (£318,800), tools and stores (£66,061), station materials and fencing (£58,552), and iron bridge-work (£53,464). These figures are interesting as they bring forcibly before us the vast strides India will have to make if we are ever to have a realization of Sir W. W. Hunter's prediction, set forth in his recent lecture on "A New Industrial Era for India," that the country will, even as regards iron-work, in course of time, become self-supplying.

**DEPLORABLE!**—The present supply of drinking-water at Trichinopoly is exceedingly unsatisfactory—in fact, in many instances, the people drink their own filth. The Wyakonda channel and its branches are defiled in every possible way, and in some places receive, not only the

town drainage, but also the contents of many foul cess-pools. The necessity of providing Trichinopoly with a supply of wholesome drinking-water has been engaging the attention of the Municipal Council for some time, and the services of a competent Sanitary Engineer was advertised for, to draw up a comprehensive scheme for the drainage and water-supply. We trust therefore that before long the drainage and water-supply of this important station will be placed on a far more satisfactory footing than at present.

**BIR!**—Bhownugger has got its white elephant. Taking advantage of the Queen's Birth Day celebration there, the Maharaja presented to the *quasi*-Municipality 450 acres of waste land. The ingenuous correspondent who informs the public of this "munificent gift" writes naively: "At present the tract is known as the 'Bir,' and is covered with babul jungle." He prophesies a sort of improved Victoria Park as its outcome. We, for our part, having some knowledge of native character, are constrained to fear a continuance of "Bir" unless Engineering talent is called to the rescue. Nothing now-a-days is impossible to Engineering skill, adequate assumption of new methods, and cheap labor, but—without such scientific guidance—we should incline to bet that bir in Bhownugger will continue to be bir, till—the millenium let us say.

**AGRICULTURAL PROGRESS IN THE N.-W. P.**—A departmental rule has been made that ploughs are not henceforth to be sold on credit. We hardly know whether this is matter for congratulation or the reverse. On the one hand it is certainly not judicious to encourage impecunious ryots in extravagance. On the other hand judicious expenditure on a plough at a time of need might, it is quite conceivable to a man of Mofussil experience, go a serviceable way towards saving the impecunious ryot from bankruptcy. Local experience would seem to be the only trustworthy guide in such a matter. Meanwhile, as a consequence of the new rule, there has been falling off in the sale of ploughs. There is also a slight decrease in the sale of pumps and waterlifts. By way of compensation sale of grain kibbling and chaff cutting machines has nearly doubled. Bull's dredgers and sugar evaporators "do not as yet find increasing sale."

**CALCUTTA TRAMWAY.**—There has been some squabbling of late in Indian Railway circles about rates and fares. Such matters are settled expeditiously in South America. A tramway company which refused to lower its rates in obedience to popular command was, the other day, at Santiago de Chile wrecked, and *looted*, therefor. They do not manage the road way traffic so well in Calcutta. Tram rates are high; the supply of tram-cars punctually seems beyond the company's powers, overcrowding is rife, the pace maintained probably about two miles an hour. If it were not so searchingly scorchingly hot many would probably feel inclined to make a fuss about this anomaly. We hope that this note may meet the eye of Mr. Maples, and other tramway people concerned. We venture to suggest to them that it is as great a mistake to keep horses too fat as it is to keep them too lean; and we opine that some sort of a whip in the driver's hand is essential to safe driving and public convenience.

**USEFUL AGRICULTURAL IMPLEMENTS.**—The demand for Messrs. Thomson and Mylne's sugarcane mill for extracting juice from sugarcane continued unabated



uring 1887-88, and is described by the Department of griculture and Land Records in Bengal as *in great demand*. The report on the Seebpore plough is flattering, at on Burrakur cast-iron, indifferent, though as many as 23 were sold during the year. The other ploughs—St. Joseph, Sealy, Still and Co.'s and the Hindustan—are not taken to yet by natives, but are largely in use at idigo farms. To the Indian ryot, the item of cost is matter of serious consideration. The centrifugal igrar evaporator is finding favor with agriculturists. The Burrakur water-lift, price Rs. 35 to 55, has been accesssfully applied on several Wards estates and has een purchased by zemindars and ryots. Messrs. Jacob and Co.'s hand-power lift, fitted with buckets, price Rs. 380, was found to be too expensive and far above the purchasing power of the ryot's pocket. It is a mistake to place uch expensive articles before the ryot, as the price and ot the efficiency is considered by him.

BOAT CANAL FROM DUMAGUDEM TO BHADRACHALAM, GODAVARI.—This is one of the projects under investigation in the Madras Presidency. An estimate, amounting o Rs. 4,55,320, was sanctioned for a canal to start from above the present tail locks at Gongole or new Dumagudem and to run for more than one-third of the distance along the Taravagu, a stream or water-course which alls into the Godavari near Setampetta. Thence it was o follow the line originally chosen for the long canal of he Upper Godavari navigation scheme which has been already excavated to a short distance above Bhadrachalam, where a flight of locks would drop it into the river at a pot favorable for the lock construction, as also for the navigation. In 1882 it was considered desirable that an alternative line for the canal between new Dumagudem and Seethampet, which would run parallel to and at a short distance from the river throughout, should be investigated. The estimate for this alternative line amounted to Rs. 2,50,000 including Rs. 5,000 for a flood bank. The excess of the alternative over the original ine was approximately ascertained to be Rs. 17,000. In his letter of the 4th January 1886, the Superintending Engineer condemned the execution of the canal on either line, except as a relief work in case of famine.

P. W. D. RE-ORGANISATION.—A Bombay paper observes on this head that the suggestions of the Public Service Commission are eminently sensible as far as they go, but it wishes that the Commission had given us their mature judgment regarding certain other points. It should like to have had the evidence of experts as to whether Executive duties and Accounts should not be entirely separated. At present the time of a professional man is almost entirely occupied in looking after accounts in the keeping of which he has never been trained, and in signing financial documents regarding which he had not the slightest understanding. It would also be interesting to learn their opinion as to the extension of the contract system. At present the attempt for one officer to look after five or six hundred miles of road is absurd. The Government is yearly cheated of a vast sum of money spent on their repairs, for it is impossible for one officer to check the number of workmen employed. It would be far cheaper to give out the maintenance of roads to contract. Again, would not large contractors have built a large building like the Central Press for three-fourths the money it has cost the Government and in half the time? But in this matter the Public Works Department are not entirely to

blame. The Government system of erecting large works by dribblets of money leads to waste in every possible way.

CUDDAPAH WATER-SUPPLY PROJECT.—This work is now in progress, but it has occurred to the Executive Engineer that the original scheme is susceptible of improvement. He proposes to substitute an 8" main for the open masonry conduit of Major Drake-Brockman's scheme, and by slightly diverting the line to the east, he proposes to supply the railway station. By the change he estimates there will be a saving of Rs. 7,800. Cuddapah being a large station, a very large number of railway employés live in the railway houses quite close to the station, and the omission to take the water to the station was always regarded as a blot on the original scheme. It is by no means the least important part of the present proposal that it meets this requirement. On this head, however, the Chief Engineer observes:—Theoretically the 8" pipe is sufficient, provided it is laid quite straight and kept clean, but it is considered the pipe should be at least 9" diameter, the theoretical discharge of which is 360 gallons per 1" according to Hawksley, and 398 gallons per 1" according to Neville. There is, however, the supply to the railway station to be taken into account, and there is nothing to shew how much this will be, but it will require an increase in the dimension of the pipe, and therefore it may be said that a 10" pipe will be necessary. It is considered that Mr. Johnston's proposals are advantageous, and that it is better the water should be carried in an iron pipe, than in a masonry conduit; but it seems doubtful if piping of the requisite dimensions can be provided without increasing the amount of the estimate.

OOTACAMUND WATER-SUPPLY.—The two great supplies of drinking water for the charming hill station are the Marlimund and Dodabetta reservoirs. The northern part of the station, as well as the native town and bazaar, receive their supply chiefly from the Marlimund reservoir, and the work of conveying and distributing the water of the Marlimund reservoir by iron pipes to the town is now in progress. No settling tanks or filtering beds have been provided in this north water-supply scheme. The Dodabetta reservoir, which supplies water to the southern part of the Municipality, is far from satisfactory in respect to its safety from pollution. The catchment area, which should be the first care, is unsatisfactory, one part of it being formed of cultivated, manured land. According to the classification made by the Rivers Pollution Commissioners in their sixth report on the qualities of water founded upon their respective sources, surface water from cultivated land is entered as palatable but suspicious, and in this case the water must be regarded at least as such, especially when manuring is going on. The water from this reservoir is conveyed along the southern part of the station by means of an open channel, and so is liable to pollution of various kinds. As the channel passes through some plantations, it is defiled by rain draining into it from over manure deposits. The Municipal Council is anxious to have the piping of the South or Dodabetta Water-Supply undertaken, but before doing so, it will be necessary to place the catchment area in a satisfactory condition and see that it is not subjected to contaminating influences.

SOUTH INDIAN RAILWAY COMPANY.—The fourteenth report of the Directors of the South Indian Railway



Company states that, up to September 15th 1887, the length of line work remained the same as in the previous twelve months, but on that date the Nellore-Tirupati section of the Cuddapah-Nellore State Railway was opened for traffic, and the working of that line—eighty-three miles—was undertaken by the Company, the total length of line now worked being thus increased to 745 miles. The total expenditure on capital account to December 31st, exclusive of stores suspense account, amounted to £4,328,713, being at the rate of £6,619 per mile, including cost of rolling-stock, which amounted to £634,807, or £971 per mile of railway. The expenditure on capital account during the year was £70,242. Of this, £19,051 represents the cost of additional rolling-stock; £24,869 outlay on bridge work, &c.; £15,213 on stations and buildings; £6,093 on plant; and £5,016 on permanent way and sundries. The total earnings for the year amounted to £491,708, and the working expenses to £337,459, or 68·63 per cent., as compared with 70 per cent. for 1886, leaving a net profit of £154,246, equal to a return on the total capital expended of £3 11s.3d. per cent. The gross receipts shew an increase over those of 1886, which were the highest previously recorded, of £20,191, or 4·3 per cent., an increase of £7,384, or 2·24 per cent., in the working expenses, being mainly attributable to the larger expenditure on permanent way renewals—fifty-six miles having been relaid during the year with 50lb. steel rails in place of the 40lb. rails, against a length of thirty-nine miles in 1886.

**NASIK TRAMWAY.**—The following are some of the conditions embodied in the Draft Rules just published. The Promoters may use, for the construction of the tramway, the portions of the provincial road, five and a half feet only in width, measured from the gutter or, where the road is in embankment, from the edge of such embankment on the north side of the road; and, for the purpose of constructing passing-places or of crossing bridges or culverts, may approach the centre of the road as far as shall in each instance be deemed necessary by the Government Engineer in executive charge of the road: Provided that if any addition to, or alteration of any bridge or culvert is, in the opinion of the said Engineer, rendered necessary by the tramway, the same shall be carried out by and at the expense of the Promoters to the satisfaction of the Engineer aforesaid. The portion of the road which the Promoters are not authorized by or under this Order to use for the purpose of the tramway, shall be left free and unincumbered for ordinary traffic and no obstruction whatever shall be placed thereon or caused thereto, without the previous written consent of the said Engineer. The carriages used on the tramway shall be moved by animal power only. No steam power or other mechanical power shall be used for this purpose, except under the authority of, and subject to such conditions as shall be prescribed in a further Order obtained under Section 8 of the Indian Tramways Act, 1886. The maximum speed shall not exceed twelve miles an hour, or such other speed as may from time to time be authorized by the Governor-in-Council; and no vehicle shall pass through any movable facing point at a speed exceeding four miles an hour. The Promoters shall at all times maintain and keep in good condition and repair, to the satisfaction of the Government Engineer aforesaid and so as not to be a danger or annoyance to the ordinary traffic, the rails and substructure of the tramway.

## Current News.

THE Public Service Commission report is now occupying the individual attention of the members of the Viceroy's Council.

THIRTEEN thousand sleepers and rails arrived by the *S. S. Clan Matheson*, from London, on Monday evening last, for the Forest Department.

MR. W. C. FURNIVALL will represent the Nizam's Guaranteed State Railway at the forthcoming Railway Conference at Simla in August next.

NIGHT patrols have been posted on the whole extent of the Burma State Railway from Prome to Toungoo on the Toungoo-Mandalay extension.

MR. HETHERSTEDT, Assistant Engineer, East Indian Railway, Allahabad, is transferred to Mogul Serai to fill the post occupied by the late Mr. Spencer.

MR. F. N. THOROWGOOD's connection with the Madras Harbour will terminate on the 9th proximo, when his three months' notice of resignation will expire.

MR. G. HUMFRIES is likely to take charge of the Seetamari extension of the Tirhoot State Railway, which has been lately sanctioned by Government.

THE work of repair and restoration of the Ceylon Railway line is steadily progressing, and it is expected that within the next fortnight the through traffic will be resumed.

THE Railway Conference at Simla is likely to be deferred until some time in September, several of the expected delegates having represented the date already proposed to be inconvenient.

THE Board of Directors of the Great Indian Peninsula Railway Company have given £500 as bonus to Mr. F. W. Stevens, under whose supervision the Company's Victoria Terminal Station at Bombay was built.

THE residence of the Dewan of Mysore, worthy of the Chief Minister of the State, has been completed at the capital. It has been erected under the personal supervision of Mr. Standish Lee, Executive Engineer.

MR. HUTCHENCE, the Deputy Traffic Manager of the Harbour Trust Board, Madras, having obtained three months' privilege leave, avails himself of the same this day. Capt. Lloyd has been appointed to act for him.

THE Mysore Government estimate that in the present year (1888-89) the receipts from the sale of sandalwood will be not less than Rs. 6,66,400. In 1886-87—a favorable year—the Forest Department realised the good round sum of Rs. 6,48,349.

THE Royal Commission upon Gold and Silver Currency held a meeting on June 28, Lord Herschell presiding, at which the final draft report of the Commission was considered. The Commission adjourned for a week, when the report will be further considered.

THE Council of the Society of Engineers announce that Mr. C. J. Light has been obliged to resign the position of Secretary to the Society through illness, a loss they very much regret; and that they have appointed Mr. G. A. Pryce Cuxson, A.R.I.B.A., as Secretary.

THE railway bridge between Mandya and Muddur, which is in course of construction, is a long way from completion. The two central abutments have been completed, and the one on the Mysore side is partly done. That towards the Bangalore side has still to be begun.

ORDERS have at last been issued by the Bridge Commissioners, abolishing the levy of tolls from the public who have occasion to cross the river on the steam ferry *Buckland*, which plies when the floating bridge closes bi-weekly to passenger traffic. The order was enforced yesterday.

SIR EDWARD BUCK, accompanied by the Surveyor-General and the Inspector-General of Forests, has left Simla to attend a Conference at Poona. Sir Edward and Mr. Ribbentrop will go on from thence to Madras, the latter crossing over to Burma after the conclusion of the business with the Madras officials.

MR. ALBERT F. A. HERVEY, the representative in India of Messrs. Siemens, Brothers and Company, conducted a most successful trial of the electric light at the new Viceregal Palace at Simla recently. Lord Dufferin and the members of His Excellency's family were present, and expressed themselves highly pleased with the result.



## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

### PATENT FUEL.

SIR,—May I be allowed to bring to the notice of your correspondents that there is a field for a good business in the now extensive coal-fields of India. At every coal-mine there must be a great amount of dust coal which the proprietors would be glad to find a market for. A company that would undertake the formation of coal-bricks, using rice water as the binding agent, or this mixed with the gum of the *peepul* or other sticky substance, should have a good business. This strikes one particularly in going through France, where many of the best lines of steam ships use chiefly these coal-bricks. In this country, with our many unbridgeable rivers, these coal-bricks should be a great boon to the Traffic Department of Railways who have so many hundred tons of coal to load and unload by coolie labor. Imagine the difference between sliding such bricks up or down an inclined plane into P. and O. and other steamers over the present method of coaling where everything and everybody from Captain downwards is begrimed.

NO—SAM.

[We know for a fact that the manufacture of coal dust *briquettes* was tried at one Colliery in Bengal, with the aid of machinery specially imported for the purpose, but the result proved unsatisfactory.—*Ed., I. E.*]

### A GRIEVANCE.

SIR,—The Superintending Engineers of Mysore have been very kind in recommending to the Local Government for the increase of pay to the Engineer and office establishments, and getting the scales duly sanctioned, as already published in your Journal. They have also been really generous in getting some Overseers and Supervisors promotions as they deserved on account of their approved and long service. After the famine of 1877-78, the Government had reduced the scales, and carried on other retrenchment on account of Public Debt, and have now introduced liberal scales as the prospects of the Province are getting better. The enclosure is a copy of the memorial submitted to the Secretary by the Upper-Subordinates appointed or promoted after the Rendition of this province, praying that their Sub-Divisional allowance may be granted, and it is rumoured that the Superintending Engineers not only recommended last year very strongly, but have lately moved the Government again to grant this remuneration to the Overseers who hold charge of Sub-Divisions. It is said that these are before the Dewan Sahib Bahadoor, whose fame for benevolence and liberality well known, the subordinates are confident, will bless them with this boon.

NO—SAM.

[The memorial referred to embodies a fair and reasonable request, and we have no doubt that the prayer will be heard.—*Ed., I. E.*]

### ACCOUNTS OF DISTRICT ENGINEERS IN BENGAL.

SIR,—In Part I. B. of the *Calcutta Gazette* of the 4th July has been published a set of Rules and Forms for the system in which accounts are to be prepared and procedure to be followed with regard to payments by District Engineers.

The forms are of course those in use in the Public Works Department, with certain modifications in cases, to meet the requirements of District Works, and therefore call for no remarks; but some of the rules appear to have been made without consulting the views of the District Engineers, who alone are competent to understand the difficulties in their situations which the introduction of new a scheme is likely to create.

An illustration of this may be made from the following:—

Rule 1 considers that the District Engineer being located at the head-quarters of a district where there is the office of the District Board is not required to have a separate cash chest. This no doubt is very reasonable, if in practice work can be performed in accordance with the spirit of this rule without any difficulty; but can it be done so? All Engineers know that the progress of a work depends upon the smoothness and regularity in their payments, and Engineers in the Public Works Department, who possess the power of making direct payments, realise the advantages of such a power, and the interests of their work are never allowed to suffer for want of a payment, but in District works the enjoyment of such an advantage by the District Engineer in the face of such a rule, is entirely hopeless.

When the District Engineer finds a payment to be urgently necessary, or when such an urgency is represented to him by any of his subordinates, all he can do is to send in a bill after passing it to the office of the District Board, where it will lie for some time with the Board's Accountant, which officer being attached to a separate office, not unfrequently considers himself as one of the District Engineer's superiors and leaves it aside to suit his convenience. The payee, in whose favor the bill has been made out, has to dance attendance on the Accountant for no little time, when after all, perhaps, he succeeds in inducing him to take up his bill before the Vice-Chairman who, if he is an official, is fairly accessible, but should he belong to the class who live upon other people's disputes, the business must wait till he has leisure. Let it be sup-

posed that the bill is passed by the Vice-Chairman; it must then have to be presented to the Chairman for his passing. This is a matter of no small difficulty; the Chairman of the District Board, be it remembered, is the Magistrate of the District, who has got thousand-and-one departments to look after, and as such, cannot afford to devote much time to any particular department, and if he does, it is at the sacrifice of work in others. It not unfrequently happens that the Magistrate has to devote his time to his other duties in preference to the work of the District Board, and thus the Board's Accountant has to watch at the door of the Chairman's chamber and to avail of an opportunity of his being disengaged from the work of some other department. This is obtained after, of course, no small amount of waiting, and, let it be taken for granted, that the bill is passed. Then follows the ordeal of getting the cheque signed. The Board's Accountant, having drawn out the cheque (which when over Rs. 100 must be signed both by the Vice-Chairman and Chairman) has to take it before the Vice-Chairman and then to the Chairman for signature. This is the process which must have to be gone through before one could expect to get a payment made for District Works, and it must be borne in mind that it must take some time before it can be performed, and this is nothing short of a week when quickly managed. This, however, is the case when all the officials are present, but should one of them (the Chairman not unfrequently is) happen to be absent, all payments must be at a standstill till his return. Now, can any District Engineer be expected to work as he could wish under such a thralldom? It is therefore very necessary to make a certain provision by which the District Engineer can make direct payments for the advantageous execution of his works.

Rule 2. makes provision for an Imprest to be allowed to District Engineers at the discretion of the Board, the amount of which will be variable, but never to exceed Rs. 1,000.

Imprests are very much disliked by many District Engineers as a large amount of public money remains at their personal risk, and is oftentimes a source of great anxiety to them when they have to go out on inspection. But the nature of their duties is such that they cannot do without it, and hence, in spite of all the dislike they may have, they are obliged to hold it, for the sake of payments by their subordinates in different parts of the district, and also by them for works and purchases. An indirectly imperative rule has been laid down, that payments from the Imprest by District Engineers and their subordinates must be limited to sums of Rs. 20 only. The limit of Rs. 20 may be, as a rule, made imperative on the subordinates, but its relaxation with regard to urgent cases should be left to the discretion of the District Engineer. For instance, there is a bill for piece work done by a petty contractor for Rs. 22, this petty contractor has perhaps a few coolies under him and can manage to work for, say, Rs. 25 without any payment, but after that he must have immediate payment, otherwise his men would starve and eventually run away to the great disadvantage of an organised work. When this bill comes to the District Engineer he can immediately pay the man and send him back to his work, but under the rule there must be the procedure of getting it passed by the Vice-Chairman and Chairman and paid by a cheque. To get through this, the poor man must have to wait at the head-quarters for days together, which costs him a good deal more than what he could have lived for in the interior of the country, and oftentimes has to enrich the Municipality and a mukhtar for violating the sanitary bye-laws by committing a nuisance on the roadside from ignorance, and at the same time has to put up with numberless inconveniences, to which he is not accustomed, and all this happens because the District Engineer is not authorised to pay him up at once, owing to his bill having been a couple of rupees more than Rs. 20, as the red-tapeism of the rules would not permit such a step. Now suppose (that the poor man, having waited for a week and spending perhaps in expensive living, presents to *chuprassees* in the Treasury and office of the District Board, fines in a Municipal prosecution, has succeeded in obtaining his payment. He hastens back to the site of his work, to find that his men have all left for delay in payment, and the work undertaken has been left unfinished and executed in a most unbusinesslike way on account of his long absence. The penalty for this state of affairs is paid by the District Board in the long run, and the chagrin and annoyance are without measure to the District Engineer and his subordinates. A work once organised and arranged for, if disturbed, it is not easy to re-establish, but what matters it to the Accountant, Vice-Chairman or Chairman of the District Board? They have not to collect men nor to contend with the difficulties of executing work in out-of-the-way places. The picture that has been drawn is a matter of constant occurrence and is the outcome of only a penny-wise and pound foolish policy adopted by officials who have lost the foresight of realising the difficulties of work from long disconnection with it, and who do not think it worth their while to consult the views of those who have to fight out a battle amidst no end of difficulties. The next point of remark in this rule is the limit of Rs. 1,000 fixed upon the District Engineer's Imprest. A limit of Rs. 1,000 may be sufficient in districts where work is carried on by regular contract, but in districts where labor is scarce and has to be imported, and hence where work is mostly carried on by piece work, this amount is far from sufficient. In districts, work is scattered over a large area, and in the working season which is



generally the cold weather, a larger amount of Imprest is absolutely necessary. In the cold weather the Chairman is out on tour and has to spend his time in most outlying parts of the district, where even the district post is not accessible, and communication with him is carried on by special messengers retained for the purpose and it thus happens that any paper sent out to his camp does not return to headquarters under a week or ten days, or perhaps more. Now, if the District Engineer has with him an Imprest of Rs. 2,000 his operations may not be handicapped by such delays. It must also be borne in mind that he also has to be very often out in the cold season, and the retention of a larger amount of Imprest is very necessary to enable him to meet the demands of his subordinates, which are more pressing in the busy season than in others. Under these circumstances, the maximum limit for a District Engineer's Imprest should be at least Rs. 2,000.

The other rules framed relate to the management of the office work of the District Engineer, which has been considerably increased by the introduction of the few forms if they are to be fully made use of every month; but in most districts all the forms there may not be any occasion to use, as very few districts have metalled roads of any considerable mileage.

By-DISTRICT ENGINEER.

#### MR. DUBERN'S ILLUMINATOR.

SIR, I am so far aware that phantom lines and illusory appearances, as "Microscopist" mentions, might come in the way, in fact unavoidably will come in the way, through primary diffraction and interference, and very likely also through secondary interference of the primary diffracted rays; that I tried my best to avoid their meshes by turning round the difficulty, instead of facing it, when the subject on which Bastian, Tyndal, Beale and others have had such close contests, is taken up and again submitted to the microscope.

The new illuminator is, to a great extent, free from those usual effects. There are, however, some times bright light fringes in the relative place that shadows would occupy, or as tails to comets. But once well recognised, they do not interfere with the appearance of object any more than the shadow of a house does with its real outlines. Generally, they may be got rid of by bringing about some "clear field" lighting. Achromatism is not so easily managed, however, with such very intense lighting of so minute objects: and higher powers, 1,500 diameters or above, bring out again very much marked interference rings or lines on the slightest departure from correct focus.

What is the charm of polarized light? A pretty plain one, if it can be reached without over great sacrifice of other requirements, namely, the probability of such light not proving so liable to reflection in any direction as usual light is, and so the chances are in one's favor in the attempt to avoid diffraction by one side of the object at least, if not by every side. And so it apparently turned out, though I had not foreseen, and was rather surprised to find, on the other side, those very peculiar and showing diffraction fringes, above referred to, in the relative position of shadows which sometimes appear as comet tails.

Polarized light is not used like that in connection with the microscope, says "Microscopist" in other words; it is used for crystallography purposes. Quite so; that is why when in conjunction with other dispositions you shall use it in a new way, you shall obtain new results with relatively low powers, that your highest powers cannot approach without sacrificing definition and general view to such an extent that correct notions to be formed from such observations are much risked.

As to the *vinci quid non* of the bacteriologist, namely, his placing a good substage condenser, necessarily at the back of the object, the light unavoidably emerging whilst fronting the observer's eye, with the object placed some where between, that needs have been done from want of a more consistent course.

If "Microscopist" will consider a minute, he should no doubt soon see that when he has placed himself in the circumstances he advocates, he will have placed the bacteria in a more advantageous position to have a good view of his eye, than his eye to have good view of them.

Has he not read of sharp duellists trying to place their opponents at a disadvantage through setting the sun at their own back and having full light to fall on their antagonist's face? Why help bacteria to do the same with him; was there but one chance of doing otherwise? Is he not offered that chance? Why not try it? Of course, the above comparison does not apply so exactly to transparent objects. Comparisons can never be exact in every respect. But this much is, the full light is similarly thrown in the observer's eye.

Moreover, when he takes this position for his eye, is it not just the very one that should be chosen for a screen to catch and show advantageously diffraction fringes?

Under such unfortunate circumstances of observation, what else could be expected but varied appearances, closely circular or crescental outlines, merging into straight lines or gratings, and actually with distinct lines having no other origin but superposition of dark diffraction fringes, but mischievously enough shewing them as constituent ones of the object observed. To express it in a way common to Engineers, the only correct view of the object should be got at but when parallax and collimation adjustment have been secured, as well as perfect parallelism of rays emerging

from the lighting apparatus (condenser or other). This adjustment would be more difficult in the case of the microscope than in the theodolite, as the distant object that should be in the line of collimation, in this case, is actually an undefined one, namely, light rays from the condenser. But then in the microscope as now used, there is a barrier to the above, namely, when truly rigorous geometrical disposition of optical requirements to provide accuracy of lines are secured, physical properties of light step in. There should be no "interference" after the above adjustment, shewing any dark markings where there are none, since the rays would be all parallel, and no deformation of object, since all the parallel rays would also be parallel to axis of the instrument, but diffraction would be at its best and blot or confuse the fine outlines that are most desirable to see; nevertheless, secondary interference of diffracted rays could yet take place. An intermediate course for want of a better one has to be adopted, namely, to use oblique lighting, so as to a certain extent send the diffraction markings to another screen than one's own eyes, and if this be insufficient to strip the object from the "hyphen" between each of very close, but yet unconnected two points, very high powers have to be used to so far diffuse this connecting light link from diffraction, as to render its influence nearly imperceptible, whilst naturally the outlines of objects, giving rise to the weaker diffraction markings, may be expected, and indeed do persist longer than their ethereal progeny as higher and higher powers are used.

This at the same time, by a proper choice of powers, eliminates superfluous light reaching the eye, and thus the process of "try and cut," repeated several times, sometimes renders very minute objects visible that were not otherwise.

But they might have been, as is proved by the illuminator, without such very high powers. Is not the  $\frac{1}{2}$  objective and a medium eye-piece power, giving a superficial amplification of over 600,000 to 1? What more is to be desired? Are not amplifications of ten thousand diameters or of one hundred millions superficial amplification simply beguiling and blinding? After diffusing, and I might say "diluting," light to such an extent, what accuracy in perception may one expect? Let any one imagine

one of the so styled live atoms catching up but  $\frac{1}{40,000}$ th part of the light which the end of a human hair catches (remember also that this one is opaque practically and the other, as transparent as glass) having that already infinitesimal amount of light diffused or spread over one hundred millions time as large an area. Moreover, as sensation of the retina to objects is only a process of differentiation of tones of light, taking the best, but very unlikely case, that the live atom stops one half of the light that is transmitted by the remainder of the field immediately around it, namely, that the tones of light are as one to a half or as one to two, and there is the retina put to the nice little task of differentiating between  $\frac{1}{100,000,000}$  and  $\frac{2}{100,000,000}$  of  $\frac{1}{40,000}$ th of that much light which is caught by a hair's end: of course, tinging is resorted to, but of course again, as stated in these researches, that is most objectionable. It is quite impossible to use the highest powers without also diffusing or dispersing light, and the more unfortunate part of it is, that other things also are dispersed to a proportionate extent, namely, the practical real lines or configuration as well as the correct formation of ideas. On the whole, this is a compromise between different appearances and ways, depending very much on the skill of the observer, and as for the minutest objects or markings there is never knowing that the sufficient amount of such skill was at work, the nature of one same object may be contested to be either this or that with the very nice possibility of both being inaccurate in the end.

That is however the optical conditions "Microscopist" supports in front of a statement untried by him (evidently) that there is an appliance practically free of some of those insuperable difficulties (for the special purpose mentioned, of course) so far as the merging of lines or outlines are concerned, and the necessity of using very high powers to resolve, or even see at all, avoided by it.

Even the statement that the very strongest light may be used without inconvenience for the search of the very minutest object, does not seem to have tempted him to try.

But "Microscopist" should not take the above criticism of the microscope use as all directed to him alone. It is pretty plain that it is in general levelled against the erroneous way or wrong position of light, object, and eye, as generally kept to for such observations.

One hundred and fifty years ago Lieberkuhn's attempt at lighting the objects in a rational manner by means of the speculum, bearing his name up to the present date, seems to have been the only step in the right direction.

The most valuable fact that a transparent surface can act as a perfect reflector to rays of a certain direction, and yet be transparent at the same part for rays of another direction, seems to have been very much under-rated. The utilisation of such optical properties is the leading characteristic of the illuminator. That enables it to bring out the power of the  $\frac{1}{4}$ " and of the  $\frac{1}{8}$ " objective, and place them in general above their much more costly and in several ways more objectionable companions, the  $\frac{1}{4}$ " and  $\frac{1}{8}$ " inch objectives.

Yet I need add, the Vertical Illuminator of Powell and Lealand



placed at the back of the objective, is using that most valuable fact: but, what an unfortunate position was chosen!

In a last letter I shall deal with the remaining objections.  
G. DUBERN.

## SIND-PISHIN RAILWAY.

### II.

SIR.—I come now to the construction of the line, and here I must part company for the time with your contemporary, who has been most imperfectly informed of various obvious points. Excepting the heavy works from Nari to Daliyal, which have been well carried out as described, the works up to Sharigh are ordinary and call for little remark, except the wanton use of curves of only 600 feet in radius combined with heavy grades, and the constant occurrence of reverse curves with no intermediate tangent, thus making correct cant in platelaying an impossibility. Everywhere along the line the mountain road experience is obvious, in the following every little convolution of the ground by a corresponding curve. Even the bridges are as stated "curved to fit the tortuous ravines," but this curving is an *objet de luxe*, not a necessity; in many places a straight line would not increase earthwork ten per cent.

The informant of *Engineering* states:—"The line (up to Suneri from Duki Road) keeps close to the river the whole way. \* \* \* There are no other works of any magnitude except in banks and cuttings, the protective walls, rip rap pitching, boulder spurs and wire gabions, securing the line against the erosion of furious floods, being however exceedingly expensive." This is perfectly true, although the furious floods have never as yet risen above 5 feet, and if the line had been carried somewhat more in, and rested on the solid ground, the "exceedingly expensive protection" works would have been almost entirely unnecessary. Section Suneri to Nassik is described with fairness. The works here are moderately heavy and the line runs through a somewhat difficult piece of country, but the large bridges so frequently referred to in the articles under criticism, have been scattered along the line with a too lavish hand, e.g., mile 184. Bridge of 1 span 150 and 2 of 40 feet. The two of 40 feet alone are ample, the *nala* being less than that width, and the headway required for the 150 feet span necessitated the steepening of the grades below the bridge to 1 in 45 and flattening those above. "Four miles above Nassik" the "straggling river is crossed four times" and it has at its *upstream* crossing one span of 100 feet and two of 40 feet, at the next lower crossing after receiving four tributaries, again a span of 100 feet and two 40 feet, and finally at the lowest crossing, after receiving more feeders, the whole river, which in the hot weather is about six inches deep and in flood about seven feet, goes through a span of 40 feet. In point of fact, 20 feet culverts all the way would have sufficed.

The statement as to 315° of circle is no doubt a printer's error for 215°, the actual curvature. This part of the line was laid out in 1880 by a Civil Engineer, Mr. Cloete, we believe, and ran along the left bank of the Altamar River from Dirgi to Sharigh, thus avoiding the useless bridge at mile 221, 4 spans of 100 feet, and by commencing the ruling grade earlier from Sharigh, a line was laid out of 1:45 which avoided the Altamar River bridge, the Dirgi tunnel, the Karez bridge (7 spans of 40 feet), the Karez tunnel, the viaduct, 4 spans of 40 feet, and the Louise Margaret bridge.

This line, however, which had no other drawback, was too simple and was abandoned in favor of the costly and imposing works described with such gusto.

Instead of keeping to the left bank of the Altamar River and making a triangular cutting in the solid limestone rock with a protecting drain, if thought advisable (though the rainfall being only about 8 inches a year, such a precaution on rock is hardly necessary) the line was altered to right bank and taken along a series of unstable rocks liable to slip, and then through the shallow tunnel referred to made by adits. In spite of the reasons given in the article under review, it passes comprehension to account for this form being adopted. That the reason of stone avalanches is an afterthought is abundantly proved by the facts that the plan shews the watershed only  $\frac{1}{4}$  mile distant, and that there is no detritus at the foot of the hill; the formation being of the peculiar circular centricinal strata not unfrequently seen in old limestone formations. Slip, there is absolutely no trace of on either bank, and drainage is, as we have above referred to, easily provided for either by cutouts every 100 feet or so, or by an upper catch-water. As it is there is much less fear of landslide or stone avalanche than of the shallow roof of the tunnel, in several places under 2 feet in thickness and nowhere more than 6 feet, falling in on a passing train, and has now to be patrolled to avoid this very danger.

I now come to the Chappar rift, which is no doubt a piece of country through which to find the most economical line would tax the resources of an adept in Railway construction.

The difficulties here, and on this 5 miles only, are not exaggerated. The description of this 5 miles and of the 30 miles Nari to Daliyal seems to have been borrowed for the whole line. This is in fact the only really hard piece of alignment on the Railway, and there is room for differences of opinion which are entitled to respect, for though I think that a straight tunnel through the hill on the right bank of the river could have been driven

in less time than it took to execute all the complicated works in the rift. I do not wish to set myself up as an infallible judge of circumstances which may have possibly precluded this course. I only say that I have studied the ground and there is no technical difficulty.

Emerging from the rift, the line crosses two of the three streams which unite at the mouth of the rift, but whereas the three streams united go through a fissure in the rock 20 feet wide and rise in flood time "30 feet deep, filling the rift from wall to wall" two 150 feet girders have been considered necessary to cross two of them only. This is another example of wasteful bridging. As to the Louise Margaret bridge, I regret to observe a statement that this "bridge was erected without the purchase of any special plant." The writer must have forgotten the two enormous iron derricks, with hinges, pins, shackles, blocks, &c., complete, which are now lying at Sibi, and which were purchased for the purpose, but not used.

The Chappar Louise Margaret bridge weighs 142 tons in its main ironwork, and if its erection really necessitated "the handling of over 1,000 tons of massive ironwork," there must be something very faulty in the plan of erection. I may note also in passing that one of the Engineers who was on the spot assured me that the whole work was executed by Mr. G. Rose, C.E., who had charge of its execution from start to finish, and Captain Scott had nothing more to do with building the bridge than sending up material as required, and ordering the mode of erection.

Between Mangi and Mud gorge the line is not very remarkable, except for the number of useless reverse curves, and the unnecessarily large bridging, e.g., near Fuller's camp one bridge of 3 spans of 40 feet is so skew that the clear waterway left is only 30 feet, and above Mud gorge a slight correction, and straightening of the alignment would eliminate several viaducts.

The greatest absurdity on the line, however, is the spiral at mile 248. Here a fall of 35 feet only is obtained in about 4,000 feet of distance. A perfectly natural and easy descent is available along the side of the hill close by, but after vainly endeavouring to introduce a spiral at mile 203 and at mile 226, it was found just possible, by putting in some reverse grades, and by going into deep cutting, to secure an example of a spiral radius 600 feet. The crossing bridge is, however, so dangerous that it is under consideration to alter it to a covered tunnel. I noticed several examples of superfluous bridging in minor details, such as one span of 40 feet with only 2 feet of headway, but I do not wish to be captious in my remarks, and the same applies to the whole section from Bostan to Quetta and Bostan Gulistan. Here a 5 feet bank has been carried through a flat open country, thus trebling the earthwork for no purpose whatever.

I now come to the matter of expense, and will pass over the *petitio principii* involved in the remarks as to "grumbling at every penny spent on national defence" with the simple statement that at a time when economy has to be most severely studied, and works of admitted necessity cannot be carried out for want of funds, it is not only natural, but right, that wasteful and useless expenditure should be criticized most severely.

All the remarks about a Railway higher than the Mont Cenis, the St. Gothard and the Arlberg are so much chitine and dust in the eyes of the public. There is no more difficulty in rising 6,600 feet in 80 miles, i.e., 1 in 64, with a ruling gradient of  $\frac{1}{64}$  than in rising 600 feet under the same conditions. Except 35 miles between the stations of Nari and Daliyal and Mangi and Dirgi there is no really difficult country traversed, and the height of 6,600 feet spoken of is a positive advantage in that climate and latitude except for the two months of January and February. Even then the "Arctic cold" will not freeze running water and skating is found impracticable because the sun thaws the ice.

If now the cost of the 40 difficult miles be set at the liberal estimate of 3 lakhs a mile, what about the cheapness of the remaining 140 miles.

I cannot follow the reasoning of the writer as to the capital cost of the nine highest priced Indian Railways further than this: (1) That the total of Rx. 18,020 arrived at includes the cost of land, compensation, numerous and well-appointed stations expensive termini, locomotive and carriage shops, rolling-stock to treble and quadruple the S. P. Railway amounts, &c., &c., and this in countries where the value of land is high. (2) That the Sind-Pishin Railway had only Rx. 7,800 to pay for land, and that the state of its equipment on the 31st of March 1887 was such that no continuous service of even a train a day was possible, and that to equip it on the most economical scale with water-supply, sidings, signals, engine-sheds, tanks, wells, and other absolute necessities it has been necessary to spend nearly another million sterling; and even now to compare it with its mud stations, and makeshift sidings in efficiency and equipment with, say the East Indian Railway, may be good enough for an English public, but makes men who know both lines smile. Even yet the line is merely a branch of the N. W. Railway dependent on the latter for rolling-stock, repairs and renewals. It has no engine sheds except one small one at Sharigh, no locomotive or carriage shops, no *pucca* stations.

In March 1887, when *Engineering* describes it as "practically complete," ten stations had no station buildings, twelve stations had no signals; water columns or watering arrangements were wanting at five, and platforms at eight.



## General Articles.

### THE DUKE OF CONNAUGHT'S NEW PALACE AT POONA.

WE are indebted to our Poona correspondent for the two illustrations, we present our readers with to-day of the new palatial residence of H. R. H. the Duke of Connaught at Poona, and of the subjoined description of the same:— It is a large, pleasant looking building, situated about midway between the G. I. P. Railway Station and the Poona Hotel. It will be washed a very light blue, with simple raised white mouldings and cornices. The ground floor will consist of a large dining-room, two bed-rooms, with bath-rooms attached, and a verandah running right round. The top floor will be flagged with dressed Shahabad stone, and the pillars along the verandah are of soft Parbhunder stone with simple but tastefully carved foliage capitals. There is also a large porch in front supported on tall, plain white pillars. The top floor consists of a large hall, two bed-rooms, two dressing-rooms and two bath-rooms, with a very pleasant room attached, which would answer admirably as an office room or library. This floor also has a verandah running right round. The verandah leads out on to a small terrace surmounting the porch. A staircase leads on to a terrace which is about forty-five feet from the ground, from which a splendid view of the Cantonment and suburbs can be obtained. On the west Gunesh Khind and Paruttee Hill can be seen, in the north a fine view of Kirkee with the Deccan College in the fore-ground is obtained, with Yerrowda Jail and the Bund Hill in the distance, towards the right. On the east is seen the Council Hall with Ghorpooree Station a little to the left. On the east, the whole Cantonment is overlooked, St. Mary's Church standing out prominently against the hills which extend away to the horizon, and which, though bare and bleak looking now, will present a beautiful sight when clothed with emerald verdure during the monsoons and cold season. There will be a very tastefully laid out garden in front of the house, where has been erected a very neat marble fountain purchased from Muraglia and Co., of Bombay, at a cost of eleven hundred rupees. The pair to this has been purchased by the Gaekwar of Baroda. Rao Bahadoor Hurry Rowjee tried hard to induce Government to sell him the large piece of ground at the back of the bungalow, and in front of the Council Hall, but did not succeed in inducing them to part with it. However, even without this addition the place will have a splendid compound. It is estimated that the total cost of the building will be Rs. 80,000.

### BETWA CANAL, NORTH-WEST PROVINCES.

#### (IV. Continued.)

THE increase under this head, for the above reasons, is Rs. 82,357 : or a total expenditure of Rs. 1,22,357 on account of escapes for the Betwa Canal, which has an estimated discharge of 1,000 cubic feet per second. On the Fatehgarh branch of the Lower Ganges Canal, which has a discharge of 600 cubic feet per second only, the amount sanctioned in 1877 for escapes was Rs. 1,43,267. The sum stated above for the Betwa Canal is therefore a most moderate allowance, especially bearing in mind the abnormal conditons under which the regulation of supply will have to be effected.

Under "Earthwork" main canal, the excess is under three heads:—

	Rs.
A. Increase of rate	... 57,230
B. Deepening of canal at head	... 87,718
C. Proposed pitching at head and berm-cutting in first 10 miles.	... 2,00,000

Total ... 3,44,948

As regards A., the rate originally put down in Mr. Hair's estimate was that prevailing in 1874. Eight years afterwards, not only had the value of labor increased, but

within a few months after the Betwa Canal had been commenced, the Jhansie-Manikpur Railway was begun, and labor was at once attracted to it. Work practically came to a standstill, and rates perforce were obliged to be raised. In addition to this, a larger amount of rock than was anticipated was met with, and this again led to a further increase of rate.

With reference to B., the increased deepening gave an increased supply over that originally estimated for of 100 cubic feet per second for 75 days during the early "khureef," or the season when water will be most urgently required. The cost was Rs. 87,718, and taking into consideration the great advantage to be gained, and the fact that there was an anticipated saving of upwards of a lakh of rupees on the head works, the order to carry out this deepening to an extent of 5 feet at canal head was given in February 1882, and to an additional 3 feet in January last.

Item C. for Rs. 2,00,000 is a proposal for forming 10 feet berms in the first ten miles of the canal, and pitching sides and bed in the first three miles. From the facts originally brought forward, it was assumed that the sides would stand at a slope of 1 to 1 and as noted when the present excavation was commenced (see Superintendent's letter No. 69, dated 12th January 1882), "In the very hard soil we have to deal with, to judge by the river banks and *kutchha* wells, dry slopes of 1 to 1 will stand perfectly, and with the same excavation section we shall, with a bed width of 20 feet, be able to allow a small water berm of 3 feet between the two slopes."

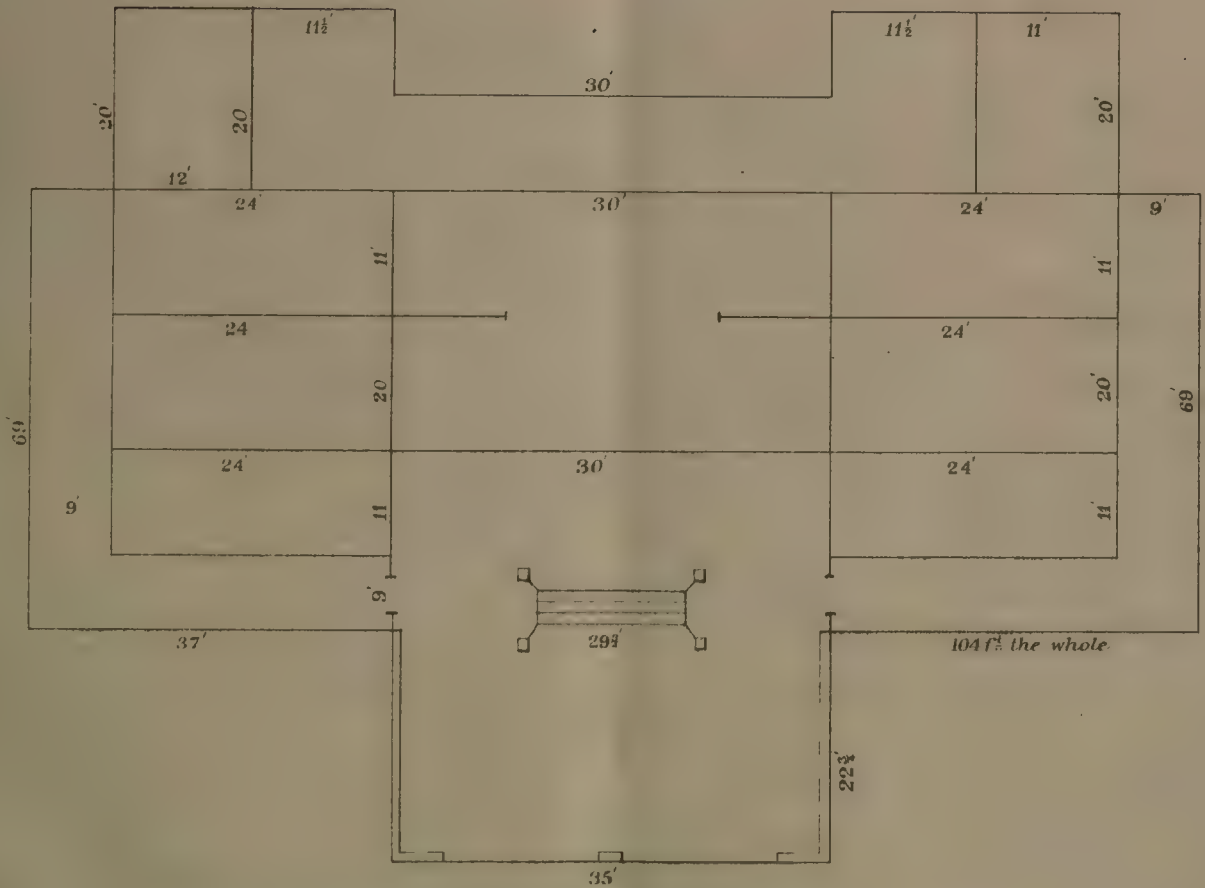
On these facts, which still hold good, and which agree with the data given by Mr. Hair, who assumed the wet slopes (on which the others depend) to be 1 to 1, the canal was excavated. Now, however, that we have nearly reached the bottom of the digging, it is seen that the lower strata are a much more friable description than was originally anticipated.

I feel extremely doubtful whether the slopes as now dug will eventually stand. In any case, I am of opinion that berms are necessary in the first five miles where the digging ranges from 40 to 25 feet, and where the bed in places is 14 feet below spring level. Orders have accordingly been given to form berms in this reach. It is almost certain that strong pitching will be required when the bed is below spring level; constant slips will occur when the water is admitted, and the only moot point is whether we should accept facts as they are, and let the banks slip, clearing out the *débris* when the canal has been opened and charging the cost to "Revenue," or openly face the difficulty, and say that we will provide against the contingency before the opening of the canal.

My own opinion is decidedly in favor of the latter. It is, I admit, a very serious thing to be considered that the capital of the canal may possibly be increased by 2 lakhs of rupees; but, on the other hand, we must face the fact that the sides will slip. This slipping will probably take place when the water is being lowered, *i.e.*, when irrigation is most urgently required, and to clear out the *débris* we shall have to close the canal at a time when water is in most demand. In addition to this untoward closure, it must be borne in mind that repairs with a running canal will cost more than protective works carefully executed at the present time. On a rough estimate I calculate that it will cost nearly 50 per cent. more to protect the banks when the canal is open than to do it now; but the expenditure will be spread over three or four or five years, and will be charged against "Revenue" and not against "Capital." As I have said above, my opinion is decidedly in favor of incurring the expenditure at once, and in this view the total cost has been entered in the present abstract.

The remaining portion of the total excess on works, *viz.*, Rs. (7,15,258—3,94,564) 3,20,694 is under the head of distributaries. The provision under this head in Mr. Hair's estimate of 1874, and in estimate of October 1881, was Rs. 1,49,590, or for 220 miles at Rs. 680 per mile.





DUKE OF CONNAUGHT'S PALACE, POONA.







The country to be irrigated by the Betwa Canal has now been thoroughly examined, and is estimated that at least 377 miles of distributaries will be required.

In all canals the mileage of distributaries is a function of the maximum volume of water to be distributed at any time, and in the Betwa Canal the conditions are such as to require large and immediate distributing power, so that in years of scanty rainfall the irrigation for the rubbee may be quickly effected and the water got on to the land before the supply in river falls below 1,000 cubic feet per second, the maximum volume which the canal is capable of passing.

This is a very important point to bear in mind, for it is agreed on all sides that water will be taken for every kind of soil to soften the ground for ploughing in years when the September rain fails; and we can always count on the river supplying a volume of 1,000 cubic feet per second to the end of October. It is, therefore, absolutely necessary to provide a sufficient length of distributary channels to meet sudden demands.

The combined maximum discharges of the Upper and Lower Ganges Canal may be taken at 10,000 cubic feet. The total length of distributaries on those canals completed to the end of 1883-84 was 4,303 miles, or at the rate of one mile of distributary to 2.32 cubic feet of maximum discharge; and the system is not yet complete. Similarly, on the Eastern Jumna Canal, the maximum discharge of which is 1,400 cubic feet, there are 618 miles of distributaries; or one mile to 2.25 cubic feet of maximum discharge.

It is, therefore, clear that an allowance of one mile of distributary to 2.5 cubic feet of maximum discharge is not an excessive estimate; and in the case of the Betwa Canal, this factor would give a length of  $\frac{1,000}{2.5} = 400$  miles, against 377 miles estimated for.

The total amount allowed for distributaries in the revised abstract is Rs. 4,70,284, or at the average rate of  $\frac{4,70,284}{377} = \text{Rs. } 1,247$  per mile, which is a moderate rate, considering that the distributaries are to be of average size, and one line, the Jaloun distributary, is to carry a khureef discharge of 200 cubic feet.

After spending nearly Rs. 28 lakhs on head works, main canal and branches, it would obviously be bad economy to starve the project in the way of distributaries.

This has been proved in the case of the Agra Canal, where it has been found necessary to double the length of distributaries originally sanctioned.

When the Betwa Canal project was originally drawn up, it was thought that a very cheap type of distributary would suffice, that land would cost little, and that masonry works would be few. But with the exception of a few miles, the distributaries are all situated in the Jaloun district, which is highly cultivated. Land is as dear as elsewhere, and bridges are as much required as in other districts. Again, the slope of the country necessitates numerous masonry falls, and the fluctuation between the early and late khureef and the rubbee supplies requires ample means of regulating the surface level of the water. Every bridge is thus either a fall or a regulator. But great care is being taken that the works are so placed as to meet the various conditions in the most economical manner, and cheap standard designs have been prepared in order to keep down rates to the lowest possible limit compatible with efficiency.

The greatest difficulty has been experienced in obtaining sufficient labor. The nature of the soil in Bundelkhund is such as to render excavation in the dry season almost impracticable; while in the rains people will not work at all in black soil if they can possibly help it, and carriage of material is quite stopped for five months in the year.

The return expected from the Betwa Canal barely exceeded 2 per cent. on the original estimated cost; but the forecast now prepared shews that notwithstanding the increased cost of the revised estimate, the net direct income, 10 years after the works are completed,

will probably be Rs. 1,50,000, or a return of  $3\frac{1}{2}$  per cent. on the total Capital outlay of Rs. 42,51,412; which includes a sum of Rs. 1,79,034, the expenditure on the project prior to 1881-82, which was not taken into consideration in the original estimate.

The improved revenue now anticipated is due to the increased storage capacity provided, and to the greater length of the distributaries proposed.

There is no want of hearty approval in the terms used by the Secretary of State in his letter of the 10th December 1885 when sanctioning the excess expenditure.

This work was sanctioned in 1881 as one of a protective character which called for early construction, at a total estimated cost of Rs. 39,82,221, of which Rs. 30,13,485 was estimated as direct, and the balance as indirect outlay. The present estimate is for a total outlay of Rs. 44,83,776, of which Rs. 42,51,412 represents direct, and Rs. 2,32,364 indirect outlay, or a total excess outlay over the original sanctioned estimate of Rs. 5,01,555.

The causes of this excess are explained fully in the note by the Irrigation Secretary to the Government of the North-West Provinces accompanying your letter, and, as must be anticipated in a work of this magnitude, are seen to arise from the adoption of improvements and alterations, the necessity for which could not be foreseen when the project was first drawn out. I have no hesitation in according my sanction to the estimate in its revised form.

I am glad to learn from your letter and its enclosures that the distributaries from the canal will be considerably increased under the present scheme, and that the work, if not already partially open, will be so far completed in the course of 1886-87 as to admit of the General commencement of irrigation.

I observe that the direct returns from the operations of the canal are estimated somewhat more favorably than when the project was first framed. I trust this may prove to be the case, but whatever may be the direct returns eventually yielded, I do not doubt that the protection from drought of a large tract of country which has always been liable to scarcity and distress will fully justify the expenditure on this work.

*Finis coronat opus.* Here is the official record of the canal's opening.

No. C. 817 L., dated 29th October 1885.

From—Colonel J. G. Forbes, R.E., Joint Secretary to the Government of the N.-W. P. and Oudh, P. W. Department,

To—The Secretary to the Government of India, P. W. Department.

I am desired to report, for the information of His Excellency the Governor-General in Council, that the Betwa Canal was opened on the 28th September 1885, and that water is running in 300 miles of channel, from 260 miles of which irrigation is now being afforded.

2. The weir 4,000 feet in length, with a maximum height of 60 feet in the deepest channel, has now stood the test of two rainy seasons with entire success, no damage of any kind having occurred. The leakage below the weir is practically nothing, and the wall itself is perfectly staunch. The calculated full supply of the river Betwa in flood is 750,000 cubic feet per second, with an afflux on weir of 17 feet. The highest flood as yet passed was on 6th August 1884, when upwards of 520,000 cubic feet were discharged with a depth on crest of 13 feet.

3. The heavy gates and powerful lifting gear of the weir sluices and head works of the canal were only fixed this year. They work satisfactorily and smoothly.

E. A. S.

HER MAJESTY'S Government has awarded a gratuity of £25,000 to Major H. S. S. Watkin, R.A., of Woolwich, for his "position finder," an invention which has been found useful in increasing the effectiveness of artillery. In connection with the same invention, Major Watkin has also been granted a retaining fee of £1,000 a year for ten years.



## THE SEWERAGE OF THE FORT OF MYSORE.

BY STANDISH LEE.

*Sanitary Engineer, Mysore State.*

## III.

## MAIN SEWER.

It has been decided to use glazed stoneware pipes for this portion of the system as well, for, though it may be constructed of brick masonry, pipe sewers afford greater facilities for rapid execution, an item of importance, seeing that the preparation of a suitable scheme has already occupied 7 years.

The plans will shew that abundant provision has been made for cleaning, flushing, and ventilating the sewer. Its location, at the extreme west, will make available, for surface drainage, the natural water courses of the locality; and its proximity to the ramparts of the fort, by affording support to the ventilating tubes, renders effective ventilation an easy matter. In its course to the out-fall, it would, however, be preferable to carry it through and under the rampart in a straight line, than to construct it as shewn on the plan, as in the latter case there will be deposits at each bend owing to change of direction and consequent heading up of sewage. When the works are in progress, the driving of a tunnel under the rampart would be a simple matter, if the services of a few Sappers could be obtained, and it could no doubt be done for less than the estimated cost of carrying it round.

The plan of ventilators and man-holes used in Calcutta is shewn by *fig. 1*, plate VIII., and that used by the Metropolitan Board by *fig. 2*. The number of these and their positions are shewn on the plan. Very few however have been provided in the estimate from economic motives.

The sewer discharges, as already stated, into the out-fall sewer of the Town, at a point where it will be inoffensive, and its mouth will be protected by a shackle valve, *fig. 3*, plate X., to prevent currents of wind entering the sewer and escaping so fast at the ventilators as to become beyond control.

## OUT-FALL SEWER.

This calls for no special report, as what is proposed is to utilise an existing drain at a point where it ceases to be a nuisance to the Fort, and to reduce its discharge to a minimum on the sewerage works of the town being carried out. At present, the filth discharges of the whole town population are carried through, what should be, the most healthy portions:—*viz.*, the Park, the lower Residency, the Dewan's quarters, the School, the Church, the Chapel, and above all, within reach of the principal façade of His Highness' Palace itself: a proceeding that has only to be mentioned to be condemned.

## SUB-SOIL DRAINAGE.

The beneficial influence of a dry soil upon health is well understood. Dr. McGann in his letter, on the drainage question, drew my special attention to the necessity for sub-soil drainage. It was therefore my intention to provide the usual special contrivances for draining the water contained in the lower strata of the ground: but on sinking trial pits in the Fort, the experience gained shewed, that the spring water-line everywhere is so low, that it is not reached at 9 feet, which is the greatest depth of the drains.

To prevent, however, saturation of the surface soil, from excessive use of Kookarhully tank water, when it is laid on, it will be sufficient to pack one-fourth of the pipe sockets, at the top, with well tempered clay, and cover the joint with concrete. This will check the entrance of sand and fine grit, but will permit sub-soil water to pass in at the top of each pipe, and thus drainage will be effected. The remaining three-fourths of the circumference will be filled up with Portland cement. "The normal state of a sewer," as aptly described by Dr. McGann, "is at least one-third full," and it can be easily conceived that with two-thirds of the pipes usually empty, water will readily percolate into them, from the top,

through the clay socket joints. It may be urged, that where water can find an inlet gas can find an outlet, but further consideration will shew, that the conditions which apply in each case are totally different. Water, for instance, slowly infiltrates by gravitation to the lowest level, displacing any air contained in the pores of the soil, which will discharge itself at the point of least resistance.

In the system proposed, there are points of ventilation throughout its range, on an average, at every 10 yards, (house gully heads); and taking a drain, such as in Alangada Street with house-connections only on one side, and therefore with fewer openings for discharge of gas than others having house-connections on both sides, it is found, that in a length of 750 feet with a 3" sewer, the contents is  $750 \times .049$  (area) = 36.7 c. ft. The number of openings in this length are 21 of 3" diameter each, or in all 148 square inches for discharging the gas generated therein.

The pipes are laid on the average 5 feet deep, the weight of a c. ft. of earth is 120lbs., and therefore the pressure on a 3" pipe is 150lbs. per foot run, or 4lbs. per square inch. For gas from the pipes to discharge into the superincumbent earth, it must attain a greater pressure than 4lbs. per square inch, which is impossible with 148 square inches of ventilating spaces. The discharge of gas through these openings under a pressure of 4lbs. will amount to 1,281 c. ft. per minute, or 35 times the cubic contents of the pipe sewer. The use of clay packing, for a portion of the joints for the admission of sub-soil water, will therefore not be attended by any discharge of unwholesome sewer gas, and is all that the circumstance of the locality requires for keeping the surface soil dry.

## DISPOSAL OF SEWAGE.

For an inland town, like Mysore, there are only two modes of treating sewage, to prevent it from becoming a nuisance—by "disinfection and precipitation," or by "sewage irrigation." According to the most recent experiments in England, it has been found, that the material obtained by chemical precipitation is less in value than the cost of such precipitation.

Irrigation seems, therefore, the most practicable method for "harmoniously maintaining unbroken the laws which sustain the chain of life from earth to plant, from plant to animal, and back again to the earth." \* \* "It has also been found, that irrigation and filtration through land produces the purest effluent water, and, when suitable land can be procured, at the least cost to the community." This is the opinion of the Chief Sanitary Officer to the London Local Government Board, after an experience extending over about 40 years.

In Mysore, we have the experience of Madras to guide us. I had the honor to introduce sewage irrigation there in 1867, and it has been successfully carried on ever since. It has proved not only an efficient method to dispose of offensive matter, but also a remunerative one.

To a Board consisting of Hindoo members, this mode of sewage disposal must readily commend itself, for they are, from their childhood, familiar with sanitary edicts promulgated by their wise men as religious dogma similar to the observances inculcated by Moses to the Israelitish people, and by which the purifying qualities of earth, "the bountiful mother of all vegetable life," receives unbounded consideration. The most successful investigations of scientific observers of the present day confirm this belief. Professor Way\* has shewn, that soils produced by the disintegration of granitic rocks, as in Mysore, consist of felspar and albite, "the former composed of a double silicate of alumina and potash, and the latter of the double silicate of alumina, lime, and soda; that when these are exposed to the contact of dead organic matter they rend apart its chemical atoms, and immediately reform them, the ammonia being greedily seized by the silicate of alumina, the magnesia and phos-

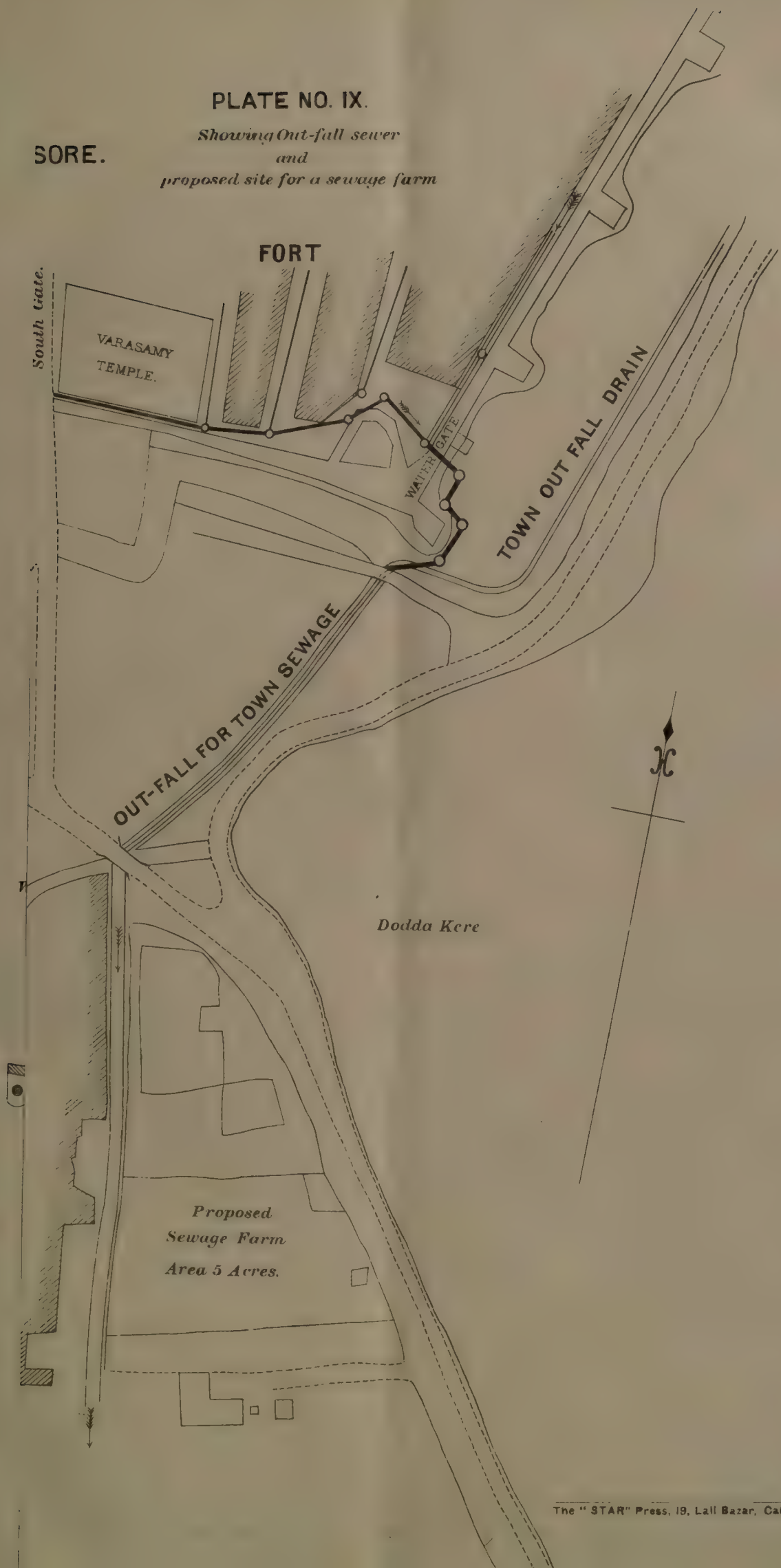
\* "On the power of soils to absorb, &c." Journal of Royal Agricultural Society.



PLATE NO. IX.

SORE.

*Showing Out-fall sewer  
and  
proposed site for a sewage farm*









phate in like manner, and in next degree the potash, lime, and soda, in proportion to their comparative absence in the original soil." Thus the most offensive organic substance is quickly transformed from a putrifying condition into that of the most perfect fitness for the food of plants.

It has been stated that the existing out-fall is to be utilised, and, therefore, the land for irrigation was searched for along its course. The most suitable plot is the one shewn on the plan, plate IX., having an area of 5 acres, which is ample for the absorption of the sewage of 5,000 people. In Madras, grass has been found the most manageable, and, at the same time, the most paying crop. It is proposed to grow it in Mysore also, where there is a ready consumption for it in the Maharaja's stables and dairy.

Should however any difficulty be experienced, during the rainy months, when green fodder is plentiful, in disposing of the large amount of green crops that sewage irrigation is known to produce, the crops can be preserved in a succulent state by compressing them into silos, and utilised during the following dry months.

To remove all apprehensions as to any nuisance arising from the proposed farming operations being situated within the town, it will be shewn that the pipe sewers will discharge their contents at the farm, before any change can take place in the substance of the sewage, and as fresh sewage is not dangerous to health, there will be nothing of a deleterious nature on the farm.

For instance, take the case of the sewage that enters the pipes at the farthest point from the outfall and under the least favorable conditions as regards inclination, viz., in Suria Pundit Street. Its course and velocity will be as follows:—

	Length.	Velocity.	Time occupied.
Suria Pundit Street ...	334 ft. at 172 ft. per min.		2'00 mins.
Across Palace garden to Madanavelas Thotti...	416 ft. at 172 "	Do.	2'42 "
Along Main Bazar Street to Motheekana Street	136 ft. at 168 "	Do.	0'81 "
Motheekana Street to Main drain ...	1,015 ft. at 197 "	Do.	5'16 "
Main drain to water gate	1,220 ft. at 146 "	Do.	8'40 "
Do. to out-fall ...	393 ft. at 173 "	Do.	2'21 "

Total mins. ...21'00

It is generally admitted that sewage kept at a constant flow does not evolve gas, and seeing that it reaches the land within 21 minutes of being produced, it may safely be assumed that there will be no foul gas and no danger to health.

#### NOTES FROM HOME.

(From our own Correspondent.)

An account is published of the last outward passage performed by the Cunard steamer *Etruria*, when she averaged 19.54 knots throughout the entire voyage from Roche's Point to Sandy Hook, which was performed in 5 days 21 hours 20 minutes apparent time, being the fastest passage as well as the fastest ocean steaming on record.

The new steamer *Rouen*, built for the London, Brighton and South Coast and West of France Railway Companies to run between Newhaven and Dieppe, went down the Firth last week for an experimental cruise. During the run she exceeded the contract speed of 18 knots per hour. On the previous day was launched the *Paris*, a sister ship, and the builders are finishing her as speedily as possible. When these two ships are on the route, the service between Newhaven and Dieppe will be about the most complete in the Kingdom.

The Royal Institution of British Architects has sent up a protest against the adoption of the scheme now submitted to Parliament for the Admiralty building extension, on the grounds that it would involve the perpetuation of evils inherent in an old and perishing structure having a short and precarious term of life, and that the application of public money for such a purpose would be unwise and unprofitable.

The machinery hall of the French International Exhibition to be held in Paris in 1889 will be covered with the largest span roof in existence. The nave of this hall will be 1,378 feet long, and the clear span will be 374 feet, the height in the

centre being 147 feet 7 inches. These dimensions are largely in excess of those of the largest existing roof in one span, that over the St. Pancras passenger station of the Midland Railway in London. This roof is 240 feet span and 98 feet high. The principals of the great French roof are pitched no less than 69 feet apart, so that the purlins exceed in span an ordinary roof. The Eiffel Tower is now up to one-third of its height. From Paris we also hear of the suppression of the numerous level crossings over the "Chemin de fer de ceinture," which runs round the line of the fortifications of Paris. Accidents have from time to time happened here, and after much trouble and opposition a sum of eight million francs has at last been devoted to the alteration of these crossings.

Three important Railway undertakings are now in progress in Yorkshire, viz., the Beeston and Batley, the Halifax High Level, and the Scarborough and East Riding Railways, all under the superintendence of Messrs. John Fraser and Sons of Leeds. In some of these the work is of a very heavy description, tunnels, viaducts and public road and other bridges. The whole of the works is to be completed in the early part of next year.

A recent issue of *Engineer* gives a colored plate representing one of Mr. Sterling's express engines for the Great Northern Railway. This engine was exhibited at the Newcastle Exhibition last year. The majestic proportions of these engines have always excited the admiration of Engineers, and the type has been eminently successful in keeping time with trains of from eleven to twenty-six coaches, so that they are as good as they look. They are looked upon as the most celebrated locomotives in the world, for they fully comply with the demands of an exceptionally heavy traffic.

The window in Westminster Abbey, which has been filled with stained glass in memory of Richard Trevithick, the first Engineer to introduce and apply high pressure steam, was unveiled last week. The window is situated in the north aisle of the nave, and is next to that in memory of Brunel. It consists of two lancets with quatrefoil tracery above. The cost has been about £1,100, and it is proposed also to endow an Engineeringscholarship in Owen's College, Manchester, and if possible institute a triennial medal at the Institution of Civil Engineers. Trevithick died absolutely penniless, and was buried by the kindly charity of those who had known him best.

A very important movement in technical education has been commenced by the Worshipful Company of Carpenters. They have inaugurated an examination of a very stringent character for those who are desirous of filling the situation of foremen or clerks of works. The first examination was held during last week at the Company's Hall to do the written work, and on the succeeding day the candidates attended at the workshops belonging to the Company at their institute at Stratford to carry out the practical work arranged by the examiners.

Mr. Abernethy's Report to the Preston Town Council on the Public Works, which has been awaited with considerable interest, has just been published. He expresses an opinion that the present works and dredging will not secure a channel beyond Lytham, and suggests that a channel from Lytham to the bar, a distance of seven miles, should be secured by the old northward channel, which could be partly walled and dredged at a cost, he estimates, of £300,000.

The Royal Commission of Inquiry into the procedure of the Metropolitan Board of Works, under the Presidency of Lord Herschell, is still continuing its labors, and from time to time disclosures are made which more than confirm the worst suspicions that were entertained before the Commission opened its investigations. The allegations principally apply to the Architects' Department, and at the last meeting of the Royal Institute of British Architects, the Council of that body asked for the complete minutes of the evidence, so that there is but little doubt they will take decisive action in the matter when the proper time arrives.

An interesting account is published of the recent trials of the Nordenfolt Torpedo which embodies all Mr. Nordenfolt's latest improvements. It is of large size, measuring 35 feet long, with a maximum diameter of 29 inches. This torpedo is self-contained, it carries its own motive power, electricity, its propelling power, steering and manœuvring apparatus, its cable, which is paid out as it travels, and its charge. At the trial it was started from an old vessel, from the deck of which it was operated by a keyboard. Some distance from the platform were placed two poles 50 feet apart, and  $\frac{1}{2}$  a mile further



down the river two more flags were similarly placed. The torpedo was started and passed centrally between the first pair of flags, continuing onwards at a speed of 14 knots to the second pair, between which it passed in a central line. It was then reversed and had a similar run back with equal results. It is understood that Mr. Nordenfelt has in hand another of these torpedoes which will carry 180 storage cells developing 34 H.P., and giving a speed of 16 knots at 1,500 revolutions per minute.

The Association of Municipal Engineers hold a District Meeting at Carlisle this week, when a paper on the Carlisle Market Roof will be read by Mr. Walmsley. Besides this paper Mr. McKie, the City Surveyor, will read several short illustrated papers on works of local interest.

It is considered a good sign to read that the Board of Trade returns for May shew a gross turn over for both imports and exports, exceeding that of 1887 by about  $5\frac{1}{2}$  millions.

The Paris water-supply has of late years been deficient every summer, so that some quarters of the City have been furnished with Seine water instead of the purer water from the Vauve, which is carried by an aqueduct through the Forest of Fontainebleau. The Government last week submitted a Bill for obtaining a supply from the springs of Lakue and Verneuil at a cost estimated at £1,670,000. The yield is estimated at 110,000 cubic metres daily.

#### NOTES FROM MADRAS.

(From our own Correspondent.)

I READ Mr. Mason's recommendations for a modification in the design of the Madras Harbour piers in your issue of the 9th ultimo. I cannot say they commend themselves to me. You see, if holes were made in the piers, that part of the energy of a wave which was not expended in the blow on the pier would pass through it and expend itself in disturbing the water inside the harbour. If the holes were large and numerous the water inside might be just as turbulent as that outside. Where then would be the use of the harbour? On the other hand, if they were small and few, very little of the energy of a wave would be taken off by them. There is another objection to the holes, and that is that the sand carried along by the littoral currents would get through them into the harbour and silt it up. The beach to the south has already grown out tremendously, but the solid walls prevent any of the sand getting inside the harbour. As regards the breakwater at Alexandria—that stands because it has never had such a thing as a Madras cyclone to resist: not because *pierres perdues* is a superior form of construction to solid bonded work. It is good enough in some cases, and it certainly is much cheaper—that is its recommendation. At Colombo, where the conditions approach to those at Madras, the solid wall has been adopted by Sir John Coode. Not only are the blocks packed close "like sardines in a tin," but they are bonded together by means of joggles and chases. This bonding is now being done in the Madras piers also. It was not done at first, and the failure of a portion of the piers during the last cyclone was probably due to the omission. The piers are also being protected by wave-breakers. These are blocks  $9' \times 9' \times 6'$  thrown promiscuously along their outer faces to a distance of forty feet from them. Here we have *pierres perdues*: but this style of construction has only been adopted because it is good enough for the work required from it, and the cheapness and comparative ease with which it can be carried out. The object of the wave-breakers is, as their name implies, to break up the waves and so reduce their momentum, and also to make them deliver their blow over a greater area of the pier.

By the way, why have you stopped giving us those papers on the Madras Drainage Works? It would be interesting to know more, for there has been a stir about them lately. At the last meeting of the Municipal Commissioners, Mr. Gantz, one of their number, brought forward a motion for getting out an Engineer from home to report upon them, as they were not working satisfactorily; or, at any rate, Mr. Gantz, representing his division of the town, was not satisfied with them. I am glad to say his motion was rejected: the majority of the Commissioners expressing their confidence in Mr. Jones' ability to bring the works to a successful issue. I hope he will. I am glad anyway that the motion to bring out a man from England was rejected, and I trust that that practice will go out altogether. What can be more absurd than getting out a man utterly ignorant of the country, to report and advise upon matters of this sort,

superseding one who is probably just as good an Engineer, and with fifteen or twenty years' local experience added to him. Another thing is, if you get a special man out from home for anything he will go in for a big thing out of compliment to himself—like Mr. Merdle's grand butler, who would never give a dinner that was not up to his mark. It did not at all matter what Mr. Merdle wanted, it was what *he* (the butler) considered due to himself that had to be provided. If there are two ways of doing a thing, a simple and cheap, and an intricate and costly, he will choose the latter as giving himself the bigger boom. I suppose this is human nature. But we need not encourage it. There is quite enough Engineering talent in the country now to supply its wants. Government appear to be realising this fact. They did not send home for an expert to advise them on the Bangalore Water-Supply question; but simply put an advertisement in your columns calling for schemes. I hear they have received *eighteen* in response, and Colonel Hasted is going to Bangalore himself to examine into them. *Apropos* of this, that criticism of mine on General Fischer's scheme, which appeared in your issue of the 9th ultimo, appears to have given great dissatisfaction to some of the good people of Bangalore. It appears there is a paper there called the *Daily Post*, which is a red-hot advocate of General Fischer and all his works, and it has taken deep umbrage at my pulling to pieces its only General. This I have learned from the *Bangalore Spectator*: I do not see the *D. P.* The *B. S.* is an old-fashioned thing like myself and is more an advocate for facts and figures than for anything else. The *D. P.* observing my own weakness that way, infers that I am its creature, and bluntly calls me so: whereas the fact is the *B. S.* does not know who I am. The *D. P.* had remarked in one of its issues that no one had pointed out any defects in General Fischer's scheme, and as a logical inference from this, contended that there were none! As if every one was so much interested in General Fischer as to notice his scheme gratuitously.

The *B. S.* dropped down upon him, and in its issue of the 27th ultimo reproduced my criticism *in extenso*. Hence these tears. I believe the *D. P.* has replied, but I have not seen his reply. If he wants me to notice it, he must publish it in your paper.

As I am upon this subject, I may as well point out another absurdity in General Fischer's scheme lest his trumpeter argue from my not having noticed it in my previous criticism that none others exist than those which I there pointed out.

We are told that water could be delivered to the station from the Hebbal tank at two annas per thousand gallons, although it is admitted that it would have to be raised 120 feet. In support of this assertion the performance of a steam engine in London half a century ago is quoted. What connection there is between the two cases is not shewn. I should have thought the present cost of supplying water from the Ulsoor Water-Works more pertinent to the case. There the water is not raised so high as it would have to be at Hebbal, but it costs *six* annas per thousand gallons. Now, whatever an engine did in London half a century ago is just as much a precedent for Mr. Smith, the Engineer in charge of the Halsur Water-Works, as for General Fischer: it is astonishing therefore that the Government do not haul him over his own coals on the strength of the General's deduction. I suppose the fact is they do not consider it sound. It may be that the air in the vicinity of the Hebbal tank is so exhilarating that the General is sanguine it would act as a tonic even to a steam engine, causing it to work more energetically and cheerfully than it could be induced to do at Ulsoor. But this explanation should have been given in the report.

Your Printers will be the death of me. The poetry which I dropped into in my last should have read—

Remember, then, what when a boy  
I've heard my Grandma tell, &c., &c.

#### BURMA.

(From our own Correspondent.)

FROM the last Report on the Administration of Forests in Burma, we learn that the general results of the work of the Forest Survey Party was less satisfactory than the outturn of the previous year; only 317 square miles was added to forest reserve against 530 square miles in 1886-87. The quantity of teak extracted, however, was larger, 45,067 tons being cut, as compared with 35,443 in the previous year, yielding a gross revenue of Rs. 21,06,740, as compared with Rs. 19,73,860,



The net revenue was therefore Rs. 1,02,872, as compared with Rs. 82,291.

The Topographical Survey Party did not turn out much work, owing to sickness amongst their numbers, and the disturbed state of the districts; only 45½ square miles of topographical survey on the 4-inch scale, and 295 square miles of triangulation, and 191 square miles of traversing was completed. The party is, however, now pushing on with rapid strides.

The working plans of the Bilin, Kadin-Bilin, and the Mokka reserves were, under the direction of the Inspector-General of Forests, redrafted. It is now proposed that 1,250 trees be girdled every five years for the next 30 years in the Bilin reserve, and the net annual yield is estimated at Rs. 6,700. In the Kadin-Bilin reserve 1,000 trees will be girdled annually for 30 years, estimated at Rs. 20,000, and in the Mokka reserve 350 trees in each year, which will yield an annual income of Rs. 6,000.

Fifty-two thousand eight hundred tons of Pingadoe was the yield of the forests in Lower Burma, which, besides supplying the local Railway lines with sleepers, was also exported to the different Railways in India and the Gun Carriage Manufactories, where it is largely used in the manufacture of gun carriage wheels.

We have good grounds in stating that the extension of the Railway line from Mandalay to Assam, *via* Bhamo, and a branch to Mogoung, with feeder roads to the Shan States, a distance of some 490 miles, will be started immediately the Toungoo-Mandalay line is opened. The necessity for the early extension was strongly urged on the Supreme Government by the local authorities, as the only means of quietening down the country, and opening out the principal trade marts in the Shan States and on the confines of China, as well as facilitating a better control over the marauding tribes inhabiting the Munnoo Valleys. This scheme was strongly advocated by Mr. H. M. Mathews, our late Engineer-in-Chief, who estimated the cost per mile to be about Rs. 74,000. He also suggested that it would be far more economical to construct a Railway than a good road, as the cost of constructing and keeping the latter in 10 years would be far more expensive than a Railway line, which would earn as the line is working.

It is believed that the staff of Engineers now engaged in the Toungoo-Mandalay construction, will be detained for the new line; but we fear that most of the subordinates will be relieved, as many of them are now laid up.

The revolution caused in this Province, during the past few years, in the rice milling industry, by German competition, is certainly worthy of notice. Some of the most prosperous of the rice mills in this City are now owned and worked exclusively by Germans, who, apart from importing their own machinery and labor, economise every item of expenditure in such a manner, that some of the oldest mills, owned by wealthier firms, find it difficult to compete with German millers with their cheaper constructed mills. Although we do not attempt to attribute any want of mechanical skill in this direction to English millers, we certainly wish to see more inventive genius displayed in an industry which has made many merchant princes of the pioneers of this trade. The experience of the past few seasons, when almost all the produce of the mills was destined for foreign ports by our foreign rivals, should, in itself, give an impetus to a profitable industry, once entirely in the hands of English capitalists.

Blasting operations in the channel of the Chindwin, where it was found necessary to remove the numerous rocks, rendering the navigation of the river dangerous, were very successfully carried out by a company of the Madras Sappers and Miners. It was estimated that about 4,000 tons of rocky material was removed. The operation was conducted with Abel fuses, fired from the shore by electrical wiring. This is the first occasion Abel's fuses were used for blasting purposes here, platinum wire and low tension fuses being hitherto used for operations of this kind. Two well insulated main leads of copper wire were used, the same as that used in ordinary electric lighting; these were fixed in the rear of the rocks, two additional mains were also carried from the machine and united with the first mains about the middle and end of the rocks, so that in case any one of the lines should fail in the transmission of the current, it would have other independent means of percolation. This system of using more than one wire should always be adopted, where the obstacles to be got at lie scattered, and when the desired effect is required at the first knock.

It is surprising with the development and growth of buildings in this rising port, that more attention is not paid by our Engineers to overhead lighting. This want is nowhere more neglected than in our large public buildings, where the inner apartments look quite dark and dismal for want of a better method of sky-lights. The old style of sky-lights is nothing to compare with the improved system lately introduced by one of our leading citizens. The invention merely consists of a metallic top, bottom and middle fastenings to wooden battens, placed horizontally, with inside channels to convey any moisture from both sides of the glass. The metal vertical bars are also turned up inside to form internal gutters, and the glass is thus secured by a double top flange. The bars finish at the hips and end of the roof, have only one inside gutter and top flange, and over this is placed a flashing or end piece. The ridge capping has also a single gutter and flange, and the flashing is dressed over it and a wooden roll. This system is certainly a boon, which besides supplying a light and durable method of obtaining overhead lighting at an economical cost, requires no puttying, painting, or other perishable cements used for glazing.

## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

India, July 14, 1888.

Lieutenant Arthur Bretherton Rouch, R.E., is appointed to the Public Works Department as an Assistant Engineer, 2nd grade, and posted to the Punjab.

Central Provinces, July 14, 1888.

*Establishment.*

With reference to Notification dated 13th ultimo, Rao Sahib D. S. Sathaye, Executive Engineer, 4th grade, temporary rank, rejoined at Nagpur, on the forenoon of the 10th current, from the privilege leave granted to him.

The unexpired portion of his leave is hereby cancelled.

N.-W. Provinces and Oudh, July 14, 1888.

*Irrigation Branch.*

Mr. M. Nethersole, Assistant Engineer, 1st grade, Traffic Manager, Ganges Canal, will, in addition to his other duties, hold charge of the Meerut Division, Ganges Canal, during the absence of Mr. E. A. Carswell, Executive Engineer, on privilege leave, or until further orders.

Mr. H. C. Sanders, Assistant Engineer, 1st grade, is temporarily transferred from the Bhognipur Division, Lower Ganges Canal, to the Cawnpore Division, Lower Ganges Canal.

Bengal, July 18, 1888.

*Establishment—General.*

The Lieutenant-Governor is pleased to make the following promotions in the Engineer Establishment, with effect from the dates specified:—

Mr. O. C. Lees, on furlough, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, *pro tem*, with effect from 26th June 1888.

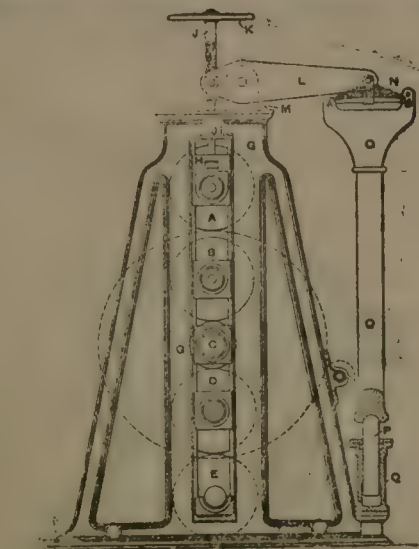
Mr. R. E. Carter, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 2nd June 1888.

Mr. G. C. Maconchy, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 4th June 1888.

## Indian Engineering Patent Register.

### RECENT BRITISH PATENTS.

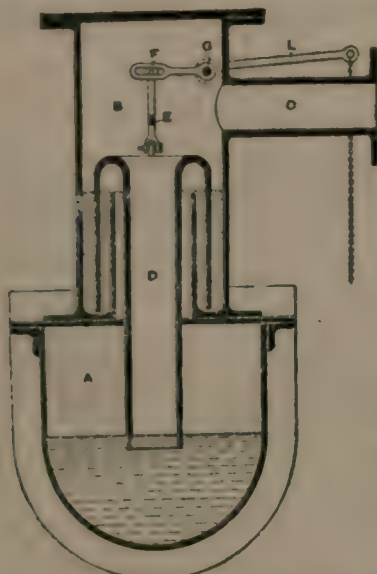
CALENDERING MACHINES.—W. W. Urquhart, J. Lindsay, and R. Allan, Dundee.—This invention is applicable to rolling machines





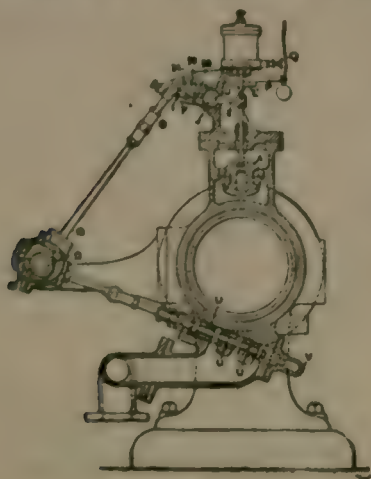
which are employed for finishing woven fabrics and for rolling paper, and its object is to improve the method of communicating pressure to the rollers. The figure shows the arrangement fitted to a five roll calendaring machine. The rolls A B C D E are mounted in the housings G; the bearing block H of the top roller is raised and lowered by means of a spindle J, which can be adjusted by means of a hand wheel K. The spindle is screwed through a block, which is pivoted between the inner ends of two plates forming a lever L; this lever is centred on a pin in a bracket M, which is cast on the top of the gable G. The outer end of the lever is connected through the spring N to the upper end of a massive vertical bar O, which is made of such a weight as to be capable of lifting one end of the roller A. The lower end of the bar O rests upon the top of the ram P of a hydraulic cylinder. The top of the ram P is of a spherical form, and fits in a corresponding cavity in the bottom of the weight bar. The pressure of water in the cylinder Q is sufficient to raise the bar O and to apply the desired pressure to the top roller A through the lever L. Three claims are made for the manner of applying the pressure in calendaring machines, for combining the counterweights with the pressure apparatus, and for interposing the springs, as described.—No. 2134. February 13th, 1888.

**RELIEVING GAS RETORTS FROM PRESSURE**—T. Settle, *Huddersfield*. The accompanying illustration shows a transverse section of the hydraulic main, dip pipe, and bridge pipe. The apparatus consists of the hydraulic main A, upon the top of which is bolted the chamber B; the lower part of the chamber is annular, and capable of containing liquid. To this chamber B is cast the bridge pipe C, which connects the chamber B with the ascension pipe. Within the chamber there is an annular dip pipe D; the outer annulus of this pipe descends and enters the liquid contained in the cup of the chamber B, while the main part of the pipe enters the liquid in the



hydraulic main. The dip pipe is suspended by a strap E, which is connected to a slotted lever F turning on an axis G. The lever L is fixed to the axis G, and a chain hangs down from its free extremity. The liquid is supplied to the cup, and the retort charged; the chain is then drawn down, causing the dip pipe to be withdrawn from the liquid in the hydraulic main so as to afford an unimpeded course to the gas. The pipe may be allowed to dip into the water slightly if a seal is desired. The annular cup will always be supplied with liquid from the condensation of the gas. By this apparatus the retort may be partly or entirely freed from pressure. Three claims are made for the dip pipe, chamber B, and manner of suspending the pipes.—No. 1274. January 27, 1888.

**VALVE GEAR** J. Richardson and B. R. Rowland, *Lincoln*.—The accompanying figure shows part of the mechanism which has been designed by the inventors for working the trip valve gear of Corliss engines. The Cornish double beat valves A admit the steam, and these and the exhaust valves U are operated by the eccentrics D on the



shaft C. The valves A are lifted by levers E, whose outer ends F are depressed by the appliance I. The upper ends of the eccentric rods G are carried by link rods H, which can describe an arc of circle; when the trippers I descend, the link rods move further from the centre of the lever E, until they release themselves from the end F. The valves A then fall instantly upon their seats. The pin J is made of a round rod, and is movable horizontally in its housings. The fulcrum J is coupled by small connecting rods M to the lever N, by which a horizontal motion is imparted to the fulcrum by the varying positions of the lever P. The lever P is connected with the governor of engine. The end F of the tripping lever is caused to approach and recede from the tripper I, and the point of cut-off is thus varied. The lever P may have a cord Q attached to it, and the cord is carried all round the mill, so that in case of accident the engine can be stopped. The exhaust valves U are of the triple ported pattern, and their working faces are those farthest removed from the cylinder. They are thus always pressed towards the face by the pressure of the steam inside the cylinder. The valves can be easily examined or removed for repairs, by simply unfastening the covers V. Four claims are made for the inlet valve gear, and for the exhaust valve as described, and for another modification consisting of an oscillating exhaust valve.—No. 3744. March 11th, 1887.

## A VERTISEMENTS.

**REQUIRED**—A Superintendent of Works for the Cooch Behar State Public Works Department. Salary Rs. 200 rising to Rs. 300.

Only experienced men with the best references need apply.

Address—

THE SUPERINTENDENT OF THE STATE.

## Akra Government Brick Factory.

**Tender for Supply of Dust and Rubble Coal.**

**WITH** reference to advertisement calling for tender for supply of dust and rubble coal, intending tenderers are requested to quote also rate for delivery by boat if necessary. Measurement taken in stacks on the foreshore, 70mds. being assumed as weight of every 100 c. ft.

S. C. GHOSE, RAI BAHADUR,  
Superintendent,  
Akra Brick Factory Division.

AKRA; }  
The 14th July 1888. }

## WANTED.

**AN OVERSEER** for the Raj Engineering Department on a salary of Rs. 80 per mensem and actual travelling allowances, for 3 months from 1st August 1888, with chance of being made permanent after that period. Passed Overseers of the P. W. D. need only apply. Applications with copies of certificates will be received by the undersigned up to 25th instant and the selected candidate must be prepared to join at once when told to do so.

CHUNDER SEKER BOSE,  
For MANAGER, R.D.

MANAGER'S OFFICE, }  
RAJ DURBHUNGAH, }  
The 16th July 1888. }

## WANTED

**A DRAFTSMAN** and Estimator. Must be able to finish drawings from pencil sketches. Pay up to Rs. 90 according to qualification

Apply to—

The EXECUTIVE ENGINEER.,

(159)

Sukkur Bridge, Sind.



## P. W. D., AKRA DIVISION.

### NOTIFICATION.

Tenders for the supply of coal for Brick burning will be received by the Superintendent, Akra-Factory, up to noon of Monday, the 23rd July 1888.

The probable quantity of coal required is about 500 tons of Rubble and about 15,000 tons of dust coal, and no tender will be considered for the supply of quantities less than one half of the above.

Tenders are to be made in P. W. D. Form No. 14M. and Rs. 200 is to be submitted with each tender as earnest money.

Tenders should specify (1) the rate per ton at which the coal will be delivered into E. I. R. waggons at the Pit mouth or at the nearest Railway siding to the Pit; (2) the rate at which despatches can be made per week after the 1st November; and (3) the name of the Pit from which the coal is raised.

For further particulars apply to the Superintendent, Akra Factory.

S. C. GHOSE, RAI BAHADOOR,  
AKRA, } Superintendent,  
The 28th June 1888. } AKRA BRICK FACTORY DN.  
(152)

## ICE! ICE!! ICE!!!

### FOR SALE.

THREE Ammonia Machines, Carrés system, 2 of 1 ton each, 1 of  $\frac{1}{2}$  ton capacity with Steam Engine, Boiler and Ammonia Still. The whole for cash. The above are second-hand having been at work 4 or 5 years. For further particulars apply to

P. C. RUBIE,  
LUCKNOW; } P.-ATTY. TO LIQUIDATORS,  
16th June 1888. } General Ice Factory Co, Ltd.  
(141)

Price (reduced)  
If 20 or more are taken  
Rs. 8-8 each  
" 8-0 "



**STONE'S PATENT**  
**SILENT SELF-FOILING PUNKAH WHEEL**  
**HORIZONTAL VERTICAL**

New and improved pattern, equally suitable for use in Churches, Hospitals and Public buildings as in Private Houses.

These wheels are Noiseless and self-lubricating, do not drop oil or allow the rope to be pulled off them. They are easily fixed in any position, answer equally well as Vertical or Horizontal wheels, and run perfectly for years without attention.

(154) Sole Agents, SPENCER & Co., Mount Road, Madras.

## Bombay, Baroda and Central India Railway,

### INCLUDING

## Rajputana-Malwa Railway.

### Tenders for construction of Railway from MUTTRA TO BINDRABAN.

TENDERS on a schedule of rates are invited and will be received up to 21st July 1888 for the execution of works connected with the construction of a Railway about 8 miles long on the metre gauge from Muttra to Bindraban on the Cawnpore-Achnera district of the Rajputana-Malwa Railway.

Forms of tender and approximate quantities of work to be done can be had on payment of Rs. 2 on application to the office of the Engineer-in-Chief, Rajputana-Malwa Railway, at Ajmere.

A sum of Rs. 500 as earnest money must accompany each tender which should be superscribed—

"Tender for execution of works on Muttra-Bindraban Extension".

Tenders should be sent under sealed covers to the Engineer-in-Chief, Rajputana-Malwa Railway, at Ajmere.

Payments for work done will be made monthly, and as security for due performance of the contract, deductions of 10% will be made from each bill till work is complete.

R. WHATELEY,  
For Engineer-in-Chief,  
R.-M. RAILWAY.

## EAST INDIAN RAILWAY.

### FOR SALE, IN GOOD CONDITION.

Steam propelling anchor heave-up boat, with 5-ton steam winch.

LENGTH 59 feet, beam 13 feet, depth  $5\frac{1}{2}$  feet, specially imported for Jubilee Bridge works at a cost of Rs. 19,110-4-10. Offers invited.

Full particulars on application to the Controller of Stores, E. I. Railway, Fairlie Place, Calcutta.

D. W. CAMPBELL,  
AGENT.  
CALCUTTA, 12th July 1888. (161)

## BEST MIRZAPUR STONE.

The Mirzapur Stone and Trading Co., Cut-Stone Contractors and Quarrymen, Mirzapur, can supply—

Flagging .. .. .	Roofing.
Pillar Bases .. .. .	Coping.

And all descriptions of Cut-Stone. The cheapest in the market.  
Apply to the Company or to

LYALL, MARSHALL & CO.,

4, Clive Ghat Street, CALCUTTA.

(158)

Depôt—Sulken, Calcutta.

### WANTED.

A GOOD Estimator, Salary Rs. 100, and a good Draftsman, Salary Rs. 60 rising to Rs. 75. Apply with copies of testimonials to—

H. F. WHITE, M.I.C.E.,  
Superintending Engineer,  
1ST CIRCLE, RANGOON.

(153)



**AUCTION SALE OF**

**Freehold Land, Dwelling House, Unfinished Graving Dock, Wharf, Sheds, Barracks, Out-offices, &c., in Rangoon.**  
The undersigned have been favored with instructions from the Executrix to the Estate of the late

**Mr. J. MACRORY, to Sell by Public Auction on 28th July**

*The whole of the valuable Landed Property belonging to the above Estate,*

**SITUATED AT DUNNEEDAW, RANGOON,**

COMPRISING

1. A portion of Suburban allotment Lot No. 17 measuring 200 by 800 feet with an unfinished Dock measuring 420 by 56 feet and 4 inches with 2 gates, each gate 30 feet by 9 inches wide.
2. A Wharf complete measuring 150 by 18 feet leading to the above.
3. Workshop sheds built of galvanized roof and walls measuring 240 by 40 feet.
4. The substantially built dwelling house 46 by 46 feet with a portico 16 by 16 feet and out-houses complete.
5. The Office and Blacksmith's Shops complete with tools, 86 by 20 feet, with galvanized iron roof.
6. Workmen's dwelling 180 by 26 feet with galvanized iron roof.

Government sanction having been obtained for constructing the dock, it affords a splendid opportunity to Capitalists to invest their money for profitable returns.

The want of a dock for a rising place like Rangoon has long been felt, which the late Mr. Macrory endeavoured to supply, but was prevented by his sudden demise, in consequence of which the above property is now offered for sale.

TERMS—A deposit of 25 per cent. to be paid on the day of sale, and the balance within one month from date of sale.

The property to be at purchaser's risk from the time of sale.

All transfer charges to be borne by the purchaser.

Not—Private offers will be received up to two days before the sale. Any information required by intending purchasers will gladly be given by

**RANGOON.**

**BALTHAZAR & SON,**

**AUCTIONEERS.**

(157)

## COMMERCIAL UNION ASSURANCE CO., LD.

*Extracts from the Twenty-sixth Annual Report viz. for the year 1887.*

### FIRE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£769,265 0 0
Interest ...	£ 13,612 0 0
Losses after deducting Re-insurances ...	£443,587 0 0

### LIFE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£125,559 0 0
Interest and Dividends ...	£ 45,649 0 0
Claims less Re-insurances, ...	£ 79,229 0 0

### MARINE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£175,118 0 0
Interest ...	£ 8,294 0 0
Losses after deducting Re-insurances ...	£138,365 0 0
Interest not belonging to above, but included in Profit and Loss ...	£ 18,545 0 0

**The Life Fund was increased during the year by £65,648 and now amounts to £1,070,064.**

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the uncalled Capital of £2,250,000.

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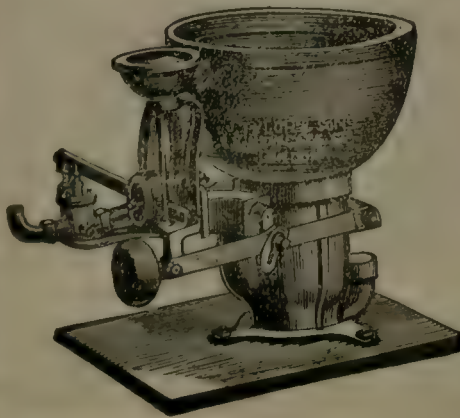
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# INDIAN ENGINEERING.

SATURDAY, JULY 28, 1888.

### ROYAL AND CIVIL ENGINEERS.

WE made some remarks in our issue of the 7th instant regarding the relative position of Royal and Civil Engineers in the P. W. D., and combated the idea that the latter had claimed that the emoluments of the former should be *reduced* so as to put all on the same footing. This reduction was however distinctly ordered in the Despatch sent out by the Secretary of State, which was laid before the Simla Committee of 1883, and only the strong influence of the R. E's. prevented its being given effect to. The C. E's. have always claimed equal treatment; but levelling up is what they have aimed at, not levelling down.

In connection with this subject we have however made such curious and interesting calculations, the results of which we now propose to lay before our readers. We have often thought it strange that in the interminable discussion that has been waged regarding the relative emoluments of R. E's. and C. E's. no estimate appeared to have been made of the gross receipts of each during an average service. It is these gross receipts that we have now worked out. We have assumed thirty-one years' service in each case, so as to give the Civil Engineer the benefit of the extra pension of Rs. 1,000 for a Superintending Engineer. As regards the Military promotion we have taken that the R. E. is promoted to Captain after 10 years' service, to Major after 16 years, to Lieutenant-Colonel after 20 years and to Colonel after 26 years. Exchange in the computation of the R. E's' pension and furlough allowances has been assumed at 1s. 6d. per rupee. If taken lower, his gross emoluments in rupees would of course be increased. Each officer is assumed to spend four years out of the thirty-one on furlough. Now, in the twenty-seven years' active service, the C. E. would, on our assumption of promotion, draw an aggregate of Rs. 2,36,000. During his four years' leave he would draw Rs. 17,400; and the pension of Rs. 6,000 a year to which he would be entitled is equivalent to a capitalised value of Rs. 75,400. His gross receipts during the whole term of service thus amount to Rs. 3,28,800. Turning now to the R. E., we find that while on active service he draws Rs. 3,05,131; while on leave Rs. 28,053; and the capitalised value of his pension of £700 a year (if he stay on longer we fancy he can draw more) is Rs. 1,16,666, making a gross receipt of Rs. 4,49,850. His receipts thus exceed those of the C. E. by no less than Rs. 1,21,050.

To put it in another way, if a C. E's. receipts are represented by 100, an R. E's. receipts will be represented by 136-8, nor is this all, for there are various advantages enjoyed by the R. E.—such as passages home in a troop-ship, the privilege of belonging to a widows and orphans fund, the fact of being able to make a trial of the department, and to leave it if not satisfied, &c.—which it is impos-



sible to represent in money value. Now we have no wish to use hard words regarding the R. E's. They act on the maxim of "Let those take who have the power, and let those keep who can;" which has been the principle of all sensible people since the world began. But, we do not suppose that any R. E. really believes that either he or his comrades are better trained for the work, better fitted for the work, and perform the work of the P. W. D. better than the C. E. These are facts that would be freely admitted by the R. E., and he would certainly maintain also that his present scale of salary is not too high. Yet from these premises he evolves the astounding conclusion that it is quite right and proper that the military scale of pay should be higher than the civil. We have never seen any reasonable defence put forward for the payment of military allowances, and we should be glad if some of our R. E. readers would enlighten us on this point.

From what we have said it seems clear either that the civil scale of pay is too low, or the military scale too high. As to which is the correct view we must leave our readers to form their own opinion. If the former, then the R. E. heads of the department should insist on a levelling-up operation. If the latter, then we recommend the subject to the notice of Sir John Gorst, who is so sensitive as regards the protests of the poor Indian ryots. Personally we are all for levelling up, being of opinion that the R. E's. are right in considering that their present scale is not excessive. But in any case, we are for equal treatment as regards salaries on the broad and indefeasible ground that those who do the same work should draw the same pay.

#### FIRES IN THEATRES AND PUBLIC BUILDINGS.

ALWAYS the subject of fires in theatres and places of public amusement has had a fearful interest for playgoers—which is by the way tantamount to saying that it has had a fearful interest for all civilized humanity. The feeling has been accentuated lately by terrible loss of life at the Vienna Opera House, at Exeter, and other places; and has given rise to many schemes for the safeguarding of life and property at places of public amusement. One of these lies now before us in the guise of a lecture delivered to the Civil and Mechanical Engineers Society in London, by Mr. Walter Emden, a recognized authority on the subject—a subject that cannot, he says, be brought forward too fully or too often until such time as good and proper legislation has placed the whole question in a position of safety. Commonsense suggests hearty concurrence with this view. It is not only theatres and places of amusement that stand in need of protection. Fires occur every now and again in churches and chapels; and usually such buildings are less protected than theatres even, and insufficiently provided with means of egress. An Englishman's Church, or his Theatre, or his Music Hall are almost as sacred to the cause of liberty, even as his house, his own peculiar castle is, and therefore it happens that in England there is no regular law providing

for the protection of such places, and their *habitués* from fire. It is admittedly a very difficult question to deal with. It has been allowed to slide.

Mr. Emden thinks that stone in a theatre is not desirable as a material. While admitting that concrete is a material, which for fireproof construction, whether of floors or roofs, is preferable to stone, or wood, or iron, he yet suggests doubts about it, and very careful investigation. Concrete of cement and gravel, or washed ballast is open to as many objections as there are to stone, he says, while for floors constructed as in a theatre it is of little or no use—being used in such thin layers. Mr. Emden's own special concrete is one the core of which is made of coke-breeze, sand, and Portland cement. The mixture to be overlayed by a concrete composed of ground slag of iron, sand, and Portland cement mixed—about 2 slag of iron and 1 of sand to 1½ of Portland cement. With such concrete, our author writes, "it is quite possible for a severe fire to burn out on the top of the floor, leaving the plaster under it intact and uninjured." About iron he suggests that in using it the greatest care is necessary. "No iron should be used which is not thoroughly encased, though strong." The very strength of iron is a source of danger when exposed to great heat, he says. Wood must be rigorously excluded.

Then one encounters a difficulty about sound and resonancy, referred to by Mr. Emden as follows: "The floors of concrete and iron (concrete of coke-breeze be it remembered) were found to be resonant enough, perhaps a little sharp in tone and quicker than from wood, but still giving a good and clear sound, the sharpness of which was much improved and rectified by the furnishing,—but the divisions of the private boxes, &c., the internal enclosing walls of the galleries and circles were a serious question. The old teaching and the best educated opinion recognised wood as the material to be used. Now the very surrounding of the galleries and circles with this material is the greatest and worst source of all the danger from fire, hence it ought not to be thought of. Numerous materials were suggested instead, and I believe that there is still some opening for improvement or invention in this direction. Out of the many suggestions made, I found that plaster on wire screens gave good sound, the wire running all through the screen of plaster giving a clear even tone to the sound; I found also a hollow interlocking brick gave good sound, and being very strong when set in cement, was more useful in any exposed position. This brick was invented for another purpose—it was for constructing of fire clay for thin strong fireproof enclosures to staircases, &c., and sound was not considered, but when erected the resounding qualities were found so good that I immediately adopted it for enclosing the circles."

Mr. Emden's plan for building is to make each tier of his erection a bridge. This is done by putting on each side of the auditorium, from the procenium wall a long girder of considerable depth. Our author calls it a "stringer." Here is his account of it:—



Each step and riser for the seating is formed throughout its length of a skeleton of angle-irons with plates rivetted upon them, thus forming a complete girder, and these are again rivetted at each end to the stringing girders which support them and form the piers of the bridge, the whole being tied in place by girders from the steps to the back wall. The whole of the steps and risers are again rivetted together, thus a whole circle forms one complete girder covering the span between the two stringers. The stringers are supported on stanchions either in the wall or thoroughly encased; this plan admits of there being no columns or stanchions in the body of the auditorium itself. Each tier, one over the other, is constructed in the same way until the roof is attained. The same principle is carried out there, but the bridge forms a dome and slopes of roof instead of steps and risers for seats. The whole of this skeleton of iron is overlaid and filled in with concrete, the underside being thoroughly encased with plaster on wire. The system itself is perfectly simple, and does not in the smallest degree appeal for a belief in any peculiar fads and fancies.

Freedom from fads and fancies is assuredly a recommendation in these times.

Of theatre curtains there are many in the market solicitous of popular approval. There is the iron curtain, formed of a double thickness of iron plates, with an air space between. A good enough machine in its way; but cumbersome, and likely to irk and worse than that in actual usage. There are canvas curtains, asbestos cloth curtains and others. But Mr. Emden holds that, up to the present time, no curtain has been invented which in an ordinary theatre would really give a theatrical audience the time necessary to get away from danger threatening premises. He says explicitly, "No curtain has been invented which in the ordinary theatre would really cut off the auditorium from the stage for more than a limited time." But, he adds—and the addition is worthy of carefullest notice—"one and all would, I think, do this for a sufficient time for the audience to escape." There is, in effect, balm in Gilead. The main question is—how to get the best and cheapest balm. Asbestos cloth is in this connection recommended, failing a better one, presently to be discovered now that attention has been directed to the subject. M. Marius, who has been giving thought to it, proposes a double thickness of asbestos cloth, stiffened by lateral bars of iron, and held in a slot at each side of the proscenium, opening by wire ropes inside the two thicknesses of asbestos cloth. The main objection to this arrangement is that a heavy mass of burning matter might tear it, particularly when hot. Such contingency would, however, not be likely to occur until a fire had made great way; and with help from lateral bars double thicknesses of asbestos and a row of water sprinklers might be still further guarded against. The Asbestos Company have another system specially devised as a protection against such accidents as we have alluded to. Their plan is to have a light iron frame made of lateral and upright bars of T-iron, which are rivetted together, and this curtain frame is covered on both sides with asbestos,

cloth. Such a curtain is fairly light and workable. Still Mr. Emden's dictum remains unchanged. "No curtain has been invented," he says, "which in the ordinary theatre would really cut off the auditorium from the stage for more than a limited time." Wanted an inventor to prolong that time, or better still to annihilate it. Now that public attention has been challenged, we do not doubt that a saviour of humanity with some turn for mechanics will accomplish all that is needful.

Meanwhile, the play-frequenting world owes a debt of gratitude to Mr. Emden for his contribution to a subject vital to its interests and welfare—a contribution full of suggestiveness, and eminently likely to prove an embryo for accomplished facts, in the future.

#### BUDGET ESTIMATES OF THE IRRIGATION BRANCH, MADRAS P. W. D., FOR 1888-89.

SECRETARIAT accounts, especially in the Public Works Department, are very possibly book-keeping triumphs. The man would be bold indeed who denied their ingenuity, their universal application to departmental affairs. But one must be an expert to understand them. It is not every budding tyro in racing affairs who can make a safe book on the Derby, and tread betting labyrinths with impunity. Somewhat of the quickness of apprehension, the ability to profit by an allusion, the neck or nothing desperation of a professional betting man must be the attributes of those who understand Public Works accounts in India. We make no pretence to such ability to see through mill-stones. But the Madras Government's Irrigation Department's revised budget estimates and accounts printed for public information, and now lying before us, are nevertheless open to criticism, and indeed invite some sort of comment.

*Allons* therefore. It goes without saying almost that this financial statement, being Anglo-Indian, shews an excess of expenditure over income. It is officially accounted for in this instance by exclusion from the accounts (under Government orders *bien entendu*) of a portion of land revenue due to Irrigation under Minor Works and Navigation. What were Secretaries made for, what do they get paid for, if not to account for departmental failures and deficits and to arrange for economies? This year they have devoted some of their energies to cutting down expenditure on those protective works that encourage agricultural settlement and promote district prosperity. Thus the revised estimate under this head is Rs. 73,800 less than the budget estimate. This sum we are told was surrendered from the grant for the Rushikulya project, as, owing to the scarcity of labor, reduction of temporary establishment, and the necessity for revising the sanctioned estimates for the project, the progress of works was not as rapid as was anticipated. The budget estimate for the ensuing year is Rs. 86,200 less than the current year's revised estimate, which is due to the Government of India having, on financial considerations, reduced the demand for the Rushikulya project by one lakh of rupees, and withheld sanction to the entire grant-in-aid proposed for the Buckingham Canal.



As to what are described as major works the revised estimate for 1887-88, it appears, exceeds the budget estimate. But an increase of navigation receipts from the Kistna delta is "anticipated." Per contra, an increase is "apprehended" owing to the sale of Government boats on the Kurnool canal and to cessation of the demand for transport of Railway materials from Cuddapah to Nandyal. The amount assigned for expenditure during 1888-89, which is Rs. 52,000 less than the revised estimate for 1887-88, has been distributed as shewn below:—

	ESTABLISHMENT.					Maintenance and Repairs.	Extensions and Improvements.	Total.	
	23 per cent. on Expenditure.	10 per cent. on Direct Receipts.	6 per cent. on Indirect Receipts.	Revenue.	Workshop establishment.				
	Ra.	Ra.	Ra.	Ra.	Ra.	Ra.	Ra.	Ra.	Ra.
Godavari delta system ..	54,740	10,600	1,000	1,000	11,000	2,11,000	27,000	40,460	4,55,000
Kistna do ..	40,940	3,687	64,500	.....	.....	1,65,000	13,000	32,873	3,20,060
Penner anicut system ..	593	40	7,200	.....	.....	1,140	1,436	91	10,500
Sangam do ..	5,060	.....	4,200	.....	.....	20,000	2,000	240	31,500
Kurnool canal system ..	23,803	1,150	5,400	.....	.....	89,000	25,000	3,045	1,48,000
Barur tank system ..	230	.....	.....	.....	.....	1,000	...	.....	1,230
Cauvery delta system ..	—1,526	851	35,400	.....	.....	—40,634	34,000	379	28,470
Srivaikuntham anicut system ..	2,631	140	6,900	.....	.....	9,792	1,648	189	21,300
Total ..	1,26,473	16,468	2,23,800	11,000	3,77,741	4,56,298	1,04,084	77,877	10,16,000

About the Red Hills Tank it is written: The Superintending Engineer, V. Circle, should expedite the resubmission of the detailed estimates for the distributaries from the Red Hills tank returned to him for revision to admit of the amount proposed for expenditure on the Madras Water-Supply and Irrigation Extension project being spent. The Government of India not having sanctioned the grant-in-aid applied for from Imperial Protective funds towards the construction of the Buckingham Canal, the Provincial grant for expenditure on works on this canal has been increased from Rs. 1,50,000 to Rs. 1,75,000, but no further increase can be made without seriously affecting the requirements for other works.

We are glad to note that tank restoration works are being vigorously prosecuted. Of their utility—provided of course that the said tanks have been located with a view to public convenience and utility—there can be no

doubt. *Apropos*, we note that the excess outlay on the Sangam anicut over the estimates submitted to the Government of India in July 1887, will be recovered by the sale of the tank beds rendered unnecessary by the project, but it is believed that fully two years from the date of completion of project will elapse before the sales are effected.

The following statement shews estimated financial results of P. W. D. work in the Irrigation Department at the end of 1888-89:—

	NET REVENUE.				Interest charges to end of 1888-89.	Surplus revenue to end of 1888-89.
	Revised estimate for 1887-88.	Budget for 1888-89.	Total.			
	Ra.	Ra.	Ra.	Ra.	Ra.	Ra.
Godavari delta	3,09,081	13,64,784	3,15,01,841	95,53,290	2,19,48,551	
Kistna do.	1,43,610	8,55,846	1,51,91,885	59,07,014	92,84,871	
Penner anicut	8,15,858	1,17,053	19,72,308	13,02,716	6,69,592	
Sangam do.	1,33,607	38,454	1,33,870	5,53,416	—4,19,544	
Kurnool canal	74,633	—55,250	—0,71,520	56,32,114	—63,03,834	
Barur tank	—.....	—1,262	—1,262	50,429	—51,691	
Cauvery delta	6,65,485	6,64,878	1,74,99,961	13,23,117	1,61,61,844	
Srivaikuntham anicut	90,216	90,371	8,70,742	8,07,894	■,848	
Periyar project	.....	.....	.....	27,980	—■,980	
Total ..	29,86,224	30,74,874	6,64,97,825	2,52,33,170	4,12,64,655	

The French Government have introduced a new material in the manufacture of ships of war by the use of cocoanut fibre, and they are already building one large vessel the sides of which are to be entirely protected by the material, with only a casing of teak outside instead of metal plates. The great advantage claimed is that any opening made by cannon balls or accident, in the side of the vessel, will almost immediately close up owing to the elasticity of the fibre. Another advantage claimed is that no matter how many balls pass through the sides of the vessel, she still will continue unsinkable, owing to the buoyant nature of the fibre.



## Notes and Comments.

**COAL IN BURMA.**—Mr. Baumgarten has gone to Burma in behalf of a Calcutta Syndicate to report on certain coal prospects in that country.

**SAD NEWS FOR SOME.**—The Engineers lent from other provinces for Public Works in Burma, we learn, are to be permanently transferred to that Province.

**BENGAL P. W. D. SECRETARIAT.**—We understand that Mr. W. B. Bestic, Under-Secretary to the Government of Bengal in the P. W. D. intends proceeding on three months' privilege leave shortly.

**SOUTH MAHRATTA RAILWAY.**—A correspondent on the Mysore Extension writes:—We expect to be open for traffic from Harihar to Berur (80 miles) in November next. Plate-laying has commenced from Harihar.

**BANGALORE WATER-SUPPLY SCHEME.**—The prize offered for the Bangalore Water-Supply Essay has been awarded to Mr. Standish Lee, who so successfully designed and carried out the Water-Supply Scheme for Madras.

**TIRHOOT STATE RAILWAY.**—We learn that next cold season will see the re-alignment of the branch line to Sitamarhi an accomplished fact; and the section between Baptiahi and the Kosi river will be ready for opening in this cold weather.

**THE KARACHI TRAMWAY.**—A correspondent writes on the 7th to the Lahore paper:—"The Karachi Tramway have brought in a bill for £70,000 against the Government for compensation for running across their tram line on the Napier Mole near Keamari."

**A RETIREMENT.**—Sir Guildford Molesworth's retirement next cold weather is announced by a Simla correspondent, and it is believed that a successor will not be appointed. We might ask on what pension does Sir Guildford retire after a long period of service in the East?

**PERIYAR PROJECT WORKS.**—The recent statements that the Madras Government intended indenting on "India" for a portion of the required staff is apparently contradicted by the Madras G. O., dated 16th June, on the subject of providing officers for this important work.

**INDIAN MIDLAND RAILWAY.**—Mr. A. C. Cregeen, Agent and Chief Engineer, Indian Midland Railway, proceeds to England by the mail leaving Bombay on the 7th August, and during his absence Mr. Paul Dangerfield, the Deputy Agent, will act as Agent and Chief Engineer.

**MACHINE FOR NOTCHING RAILWAY SLEEPERS.**—Mr. Wernigg, Loco. Workshop Foreman of the Burma State Railway, has invented a machine for notching sleepers of very hard wood. It is driven by steam power, and guided by an ordinary coolie, notches 120 *pynkadoe* sleepers per hour.

**KEROSINE.**—We have received complaints relative to the kerosine oil tins now under importation being over-marked as regards their contents, and this is ascribed to the effect of the duty now levied on that article. The shortcoming is made good by the American ingenuity of adulterating the oil with earthy matter.

**RAILWAY EXTENSION TO TRAVANCORE.**—The Government of H. H. the Maharajah of Travancore has offered to the South India Railway Company to guarantee 4 per cent. interest on the cost of the proposed line of Railway within Travancore, or from Quilon to the British frontier, provided the Company will undertake to construct the whole of the line from Quilon to Tinnevely.

**BENGAL IRON WORKS.**—An expert, representing a large company at Home, has visited and reported on the prospects of the iron industry round and about Burrakur. After examining the locality and its mineral resources, he went away favorably impressed, leaving an impression behind him, that the commencement of extensive operations would soon be an accomplished fact.

**AN ITEM FROM THE STRAITS.**—Singapore within the zone of perpetual deposition has fears with regard to a failure in the water-supply. We think that unless something very extraordinary happens, Singapore will always have plenty of water. In connection with this it is interesting to learn that the conservative Chinamen are beginning to see the advantage of having water laid on in their houses.

**ONE THOUSAND-TON TRAIN ON THE E. I. R.**—A correspondent wishes to know how many couplings have given away since the 1,000-ton trains have been introduced on the chord line of the E. I. R., and how many mishaps and runaways have occurred in consequence. Further, he wishes to point out the difficulties and delays that arise from the fact of the inadequate standing room provided at meeting stations.

**EUCALYPTUS.**—Dr. Bidie of Madras is not aware that there are any reliable data to show that the resinous odour given off by trees of the Eucalyptus family has, as popularly supposed, any influence in reducing malaria, but observations in Algeria have proved that the ordinary *Blue-gum* "absorbs and evaporates eleven times the rainfall, extremely malarious places being rendered healthy in this way in four or five years."

**THE DRAINAGE OF BENARES.**—The Benares Municipality have applied to the Local Government for the services of an expert to thoroughly examine the present drainage system and to prepare a project for carrying out the necessary improvements. The Local Government have, we believe, applied to the Government of India for such an official. This Municipality have been very unfortunate in the matter of their drainage and conservancy work.

**THE PAUMBEN CHANNEL.**—The construction of this work has been definitely placed in the hands of the English firm of Messrs. Glover and Company, who built the Prince's Docks, Bombay, and also made the original survey for the Paumben Channel scheme about two years ago. The altered plans and surveys, prepared on the spot about a year ago by Monsieur Poilay, the French Canal Engineer, for the Parisian syndicate of contractors, have been adopted.

**THE RAILWAY CONFERENCE.**—The following list of papers circulated will give a good idea of the scope embraced by the Conference:—1. Formation of a Railway Clearing House in India. 2. Method of obtaining more work out of locomotives. 3. Comparative cost of constructing Indian, English, and American Railways. 4. Framing of general rules under section 8 of the Railway Act of 1879, for working construction trains before the opening of lines to traffic.

**THE NILGIRI RAILWAY.**—The Nilgiri Railway is a splendid instance of the way "how not to do it." During the last ten or twelve years it was written about, talked about, and thought about, but nothing more has been done, and as far as can be seen, the railway is as far from being an accomplished eventuality as ever. This is most certainly not creditable to those concerned, and yet they appear to be anxious to see the line begun and completed. The pro-



ceedings connected with it must have passed through every department of the "Circumlocution Office," and another method might possibly be adopted.

**PERIYAR PROJECT WORKS.**—During the absence in England, on special duty, of Colonel Pennycuik, R.E., Superintending Engineer, Periyar Project Works, the Executive Engineer of the Periyar Division—Mr. H. S. Taylor—will be under the immediate orders of the Chief Engineer for Irrigation, and will exercise the powers of a Superintendent of Works, as defined in paragraph 240 of the Public Works Code. It is understood, however, that this order gives the Executive Engineer no claim to extra allowances on account of the special powers temporarily vested in him. This is economy with a vengeance.

**THE MADRAS HARBOUR WORKS.**—The Madras Harbour Trust Board have unanimously passed a resolution that, having regard to the long delay in the decision regarding the north-east entrance to the harbour, the Honorable Mr. Turnbull, a trustee, and Messrs. Chambers and McLintock, lately trustees, who will all shortly be at home, be asked to express to the Secretary of State the views of the Board with regard to a north-east entrance and other matters. The Government of India have sanctioned an advance to the Harbour Trust Board of Rs. 12,00,000 for 1888-89 for expenditure on the works.

**AMALGAMATION OF RAILWAYS.**—A contemporary observes that orders have been issued by the Government of India for the immediate handing over of the Tirhoot State Railway to the Agent of the Bengal North-Western Railway on formal lease. It understands that a representation will be made shortly by the zemindars and leading men of Tirhoot to His Honor the Lieutenant-Governor of Bengal for the postponement of the carrying out of this change till the question has once more been gone into thoroughly, but it does not think that it will be of any avail, as the present order is evidently final.

**A BAD PRECEDENT.**—A correspondent writes:—The Vice-President of the Rangoon Port Trust, who is also Chief Collector of Customs, occupies spacious quarters in the Custom House on the strand, for which he pays a rent of Rs. 40 per month. As his presence there is required more in the interests of the Port Trust than the Customs, it would appear rather anomalous that the State should provide him with such cheap quarters while it has to hire buildings for its own offices at three times the rent paid for similar accommodation to what the Vice-President enjoys. The Port Trust office is in the same building, and, like the Irish, pays no rent.

**THE EAST INDIAN RAILWAY.**—A Memorandum has been circulated by Mr. E. W. Crawford, Chairman of the Board of Direction of the East Indian Railway, in continuation of a paper issued in June last shewing the working of the East Indian Railway Undertaking during the eight years 1880—1887 inclusive. The Memorandum is written and made public as a vindication of the broad principles which underlay the policy of 1879; as a record of the magnitude of the interests involved in the prosperity of the East Indian Railway Undertaking; and as a factor in the consideration of the re-settlement of existing Systems now under discussion.

**TECHNICAL EDUCATION—AGAIN.**—The Government of India have just published a long and important Resolution on education, more especially with regard to techni-

cal education. In regard to the latter Government deem it premature to establish schools on such a scale as those in European countries, but consider support should be given to technical as an extension of general education. The Resolution suggests that Schools of Drawing and Design might be profitably attached to the great Railway workshops and factories, to begin with; while an industrial survey should be undertaken of each Province by educational experts and professional men.

**JUTE.**—The plant of this fibre, which is one of the chief exports from India by sea, is grown only in Bengal, chiefly in the Northern and Eastern tracts, and in Madras and Assam. The total area under jute in India may be roughly estimated at  $1\frac{1}{2}$  million acres, and the outturn at  $14\frac{1}{2}$  million cwt. The area for Bengal alone is estimated at  $1\frac{1}{2}$  million acres, and the outturn at  $13\frac{1}{2}$  million cwt. Bengal exports more than half its produce, mostly by sea; Assam may be said to do the same, its consignments which average 110,000 cwt. yearly proceeding to Bengal for shipment. The jute grown in Madras is chiefly for local consumption, very little being exported.

**THE SAME OLD STORY.**—An allotment of Rs. 60,000 towards the Gadilam and Ponniar bridges has been sanctioned by Government for the current year, but the Madras Public Works Department will arrange for forwarding to England the indent for the iron-work required for the bridges. The earliest possible intimation, the Government direct, should also be given to this Department in regard to the necessity of payments in England on account of iron-work, &c., in the current year, in view to an additional allotment being sanctioned for this purpose. When, however, emergencies arise, and difficulties happen, local sources are looked to, and not foreign, to meet them.

**THE FAIRLIE SYSTEM FOR STEEP INCLINES.**—We glean from one of our foreign exchanges that a Commission was sent out by the Indian Government last year to examine the methods employed in working steep inclines in this and other countries, and after an examination of the Fairlie system as used on the Mexican Railway, reported strongly in favour of the Fairlie engine, the conclusion of the Commission being that it could haul a train fully 50 per cent. heavier than that taken by an ordinary Consolidation engine, while the speed was also somewhat greater. This is, of course, the result of the greater adhesive weight and tractive power of the Fairlie, which has twelve driving wheels and four cylinders.

**SIND-PISHIN RAILWAY.**—*The Civil and Military Gazette* writes:—INDIAN ENGINEERING this week publishes a leading article criticising the account which its London namesake gives of the Sind-Pishin Railway. As usual, when an English paper undertakes to give accurate details of an account of an Indian undertaking, the Indian critic has an easy task in shewing that every paragraph contains a grievous blunder. We have at different times given our own opinion of that most costly Railway, and little good would be served by slaying the slain again. But it is really a pity that when an English paper takes the trouble to go deeply into an Indian subject, it cannot be supplied with accurate facts to go upon.

**JOINT STOCK CONCERNS IN BENGAL.**—From the statement shewing the number of existing companies working in Bengal for the year ending 31st March 1888,



as published in the last *Calcutta Gazette*, it appears that there are 24 Banking and Insurance Companies with a paid-up capital of about 17 millions, 29 Trading Companies with 15 millions, 28 Mills and Presses with 19 millions, 126 Planting Companies with 34 millions, 11 Mining Companies with 8 millions, 4 Ice Manufacturing Companies with about 7 millions, 1 Sugar manufacturing Company with 16 millions, and 5 others with many more millions. In all 228 Companies, with a nominal capital of Rs. 11,37,19,575 and with an actual paid-up capital of Rs. 9,85,97,905, are working throughout Bengal.

**NEGLECTED AND SLIGHTED.**—Mr. Noble Taylor, the Chairman, complains strongly of the way in which the Madras Railway Company have been treated in regard to recent Railway extensions. He says it cannot have been intended that extensions should be made in any direction for the purpose of diverting traffic from the Madras Railway, of which they are the natural feeders, in order to benefit the Railway of another company on a different gauge. Yet such will be the result of an arrangement by which the working of the metre gauge State Railway from Guntakul junction to Bezvada has been given to the Southern Mahratta Railway Company. The working of the Nellore-Tirupatti line, also on the metre gauge, was offered to the South Indian Railway, and it is now proposed to make extensions by the same agency from Tirupatti to Pakal, and thence southwards across the Madras Company's south-west line near Vellore to Villapuram, which is close to Pondicherry, and northwards from Pakal to Dharmavaram, where the new line joins another proposed extension to be made by the Southern Mahratta Railway Company from the Madras Company's junction at Guntakul to Hindupur.

**IRRIGATION OPERATIONS, N.-W. P., FOR THE RABI SEASON 1887-88.**—The demand for canal water during "Rabi," 1887-88, was increasing rapidly until the end of December, when rain fell in the upper districts and gave a check to irrigation on the Upper Ganges Canal. Late in January there was good rain over the whole Doab. This was supplemented by showers in February, after which date there was practically no further irrigation from canals. Excluding the Tarai and Bhabar Canals, the returns for which were shewn last year for the first time, the area irrigated is 904,852 acres, against 821,994 acres in 1886-87, or an increase of 82,858 acres. On the Upper Ganges Canal there is a slight increase only. The Lower Ganges Canal shews an increase of 71,686 acres, due chiefly to the lateness of the cold-weather rains in the Lower Doab. There is a falling off of 26,627 acres on the Eastern Jumna Canal, attributable to very large sowings of gram, a crop which ordinarily does not take canal water. The decrease of 5,405 acres on the Agra Canal was caused by favorable rain in the upper trans-Jumna districts. On the Betwa Canal there is an increase of 15,914 acres, due to expansion of irrigation, and also to lateness of rain in the Jalaun district. The increase of 16,948 acres on the Rohilkhand Canals is due to rain in September, which enabled cultivators to prepare a large area of rice land for "rabi" crops, for which canal water had subsequently to be taken. The remaining minor works show increases, due to the nature of the season, except on the Tarai Canals, where there is a falling off of 1,957 acres, the cause of which is not explained.

## Current News.

JODHPUR is suffering from water scarcity.

EIGHTEEN Indian Railways will be represented at Simla at the Conference in September.

THE forthcoming Poona Exhibition promises to be by far the largest ever held in the Bombay Presidency.

LIEUTENANT-COLONEL W. J. HEAVISIDE, R.E., has retired from the service with effect from the 17th instant.

A LONDON telegram states that the report of the Deccan Mining Committee will be presented before the end of the month.

WE understand that the bridge over the Indus at Sukkur is at last making such good progress that it will probably be finished some time next year.

THE speed on the Sitapur-Seramow Railway has been reduced to ten miles an hour between Luckimpur and Gola-Gokarnath, owing to the condition of the line.

THE Chief Inspector to the Marmagao Railway has reported to the Goa Government that the breach in the railway line cannot be repaired in less than a month's time.

THE Government of India have sanctioned the number of students in the Native Military Survey class of the Thomason College, Roorkee, being increased from 15 to 26.

THE train containing the English mails on the way from Calcutta to Bombay was derailed near Nassick early on last Monday morning. It was apparently done by professional train wreckers. No lives were lost.

MR. J. ELIOT, Officiating Meteorological Reporter to the Government of India, has left Simla for Bombay, to discuss with the authorities there the arrangements for the storm-warning system, and other matters relating to the Department.

THE field of investigation of the Deccan Mining Committee has been somewhat narrowed by the party obligations of some of its most influential members to do as little damage as possible to the Government in settling the terms of its Report.

THE Class and Prize List and Diplomas of the Royal Agricultural College, Cirencester, for the Spring Session of 1888, just sent out by the India Office authorities, show that three at least of the Indian scholars there have done well in the several examinations.

THE Works on the new Pegu Bridge and the Abya sluices have been stopped owing to the rains. Work will be recommenced in October. Mr. H. G. Billings, Assistant Engineer, has in the interval been appointed to act as Personal Assistant to the Chief Engineer.

THE employés of the Madras Harbour Works, as the most suitable means of expressing their affection and regard to Mr. F. N. Thorowgood, Superintending Engineer of the Harbour Works, previous to his departure from Madras, have presented him with a gold watch.

RETURNS shew that the value of the unmanufactured brass and copper imported into the Punjab from all sources amounts to nearly thirteen-and-a-half lakhs of rupees annually, without taking into account the probably large though unascertainable quantity of old metal which is worked up into new forms.

THE N.-W. Railway have just built 500 goods wagons of a large and improved type; they are by far the largest vehicles on any railway in India. In breadth they are 10 feet and in length 22 feet, with a carrying capacity of 11 tons each. The wagons are constructed so as to carry merchandise as well as live-stock, and are water-tight and spark-proof.

THE first lot of machinery intended for the Kojak Pass on the frontier railway of the Bolan,—including an engine, machinery, and winding gear,—was despatched from Lahore the other day on four large bogie trucks; a second lot will be despatched shortly. The above was executed in the Railway workshops, and is no doubt a very great piece of work of a difficult nature. It occupied fully six months, day and night work, to be turned out.

IN a late Resolution it has been directed by the Government of India that the property of the State in all forest lands and waste lands in a Province will for the future be classified as follows:—A. Classed State Forests and Waste Lands (*viz.* such as come under the Forest Act)—(a) Reserved Forests; (b) Protected Forests; (c) Village Forests; B. Unclassed State Forests and Waste Lands (*viz.* such as do not come under the Forest Act).

THE prize of Rs. 1,000 offered by the Government of Madras for the best essay on the Bangalore water-supply scheme has been awarded to Mr. Standish Lee, of Mysore. The essays of Mr. A. Garratt, Executive Engineer, Bellary, and Mr. S. Tomlison, Deputy Chief Engineer Bombay Water-Works, were considered worthy of honorable mention. Mr. Lee has proved that India has indigenous talent enough to manage her own public works.



## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*

### R. E. S. AND C. E. S. IN THE P. W. D.

SIR, I understand that another vigorous attempt to induce the Government of India to equalize the footing of the Civil, and Military members of the Public Works Department is on foot, and that the Civil Engineers Defence Committee are endeavouring to raise the question again. Having regard to the fact that the Secretary of State has already ruled that the two classes of members should receive equal treatment, that the Civil Engineers of the P. W. D. have been ruled by him to be out of the Uncovenanted service, and that the injustice of denying them the same treatment as their military brethren has been widely conceded, there seems to be little doubt that if their claims are now energetically pressed they have a better chance of success than at any previous time. The Royal Engineers having been admitted two years ago to Staff Corps sterling pensions gives a strong reason for extending the same to C. E. S.

CIVIS.

### MADRAS BREAKWATER.

SIR, In your issue of 14th instant there is an interesting letter on the above subject by Mr. A. H. Mason, Executive Engineer, Damukdia, E. B. S. Railway, in which, referring to the softening of cast iron pipes in sea water, he says: "Glazed earthenware pipes could be turned out by Messrs. Burn & Co., at their Potteries, and would be cheaper, but the salt water would take off the glaze in a short time." This, however, is a mistake, as these pipes are of salt glazed stoneware and are quite unassailable either by salt water or by acids. The glaze is not a superficial composition spread over the outside of the pipe, but the salt is absorbed at a high heat during the process of burning and is chemically incorporated with the material of which the pipe is made, the result being that the material itself has a polished surface which is intensely hard and compact, and unaffected by the solvents or corrosives of ordinary experience.

7, HASTINGS STREET,  
CALCUTTA;  
23rd July 1888.

BURN AND CO.

### DARJEELING-HIMALAYAN RAILWAY.

SIR,—At a late meeting of the Darjeeling-Himalayan Railway Company it was decided to increase the rolling-stock and goods carrying capacities of that most successful little hill line. It must be gratifying to its shareholders and supporters to know that this increase has been necessitated by a steady business-like growth of traffic carried.

The need for more locomotives and trucks too has been accentuated lately by the unusually heavy pressure thrown on the line consequently on the transport of munitions of war, baggage, &c., on their way to the expeditionary force in Sikkim.

That is a temporary embarrassment, but to embarrassments of one sort or another calling for the employment of extra rolling-stock the line must always be liable.

The embarrassment arising from increase of trade is not temporary, is likely to make greater and greater demands on the Company's carrying power year after year. More locomotives and trucks are sure to be required. It will be well to procure them early and so to avoid vexations and money wasting deadlocks, accumulations of traffic running to seed, so to speak; and lawsuits about demurrage and depreciated values, and so forth.

TRAVELLER.

### A GRIEVANCE.

SIR,—I shall feel so much obliged to you if you would agitate and stir up the Government about the warrant grades in the P. W. D., as it is really deplorable to look forward to what a man can arrive at. For instance, there is an individual with his 10 years' departmental service, and not yet near being made Sub-Conductor, having 15 years more only to serve before attaining the age of 55, making a total length of service of 25 years, and I suppose a Conductor's pension is all that can be attained. Rs. 90 per month—a fine prospect! On his first step of promotion he shall have 32 Sub-Conductors and 16 Conductors before him and how can those men be cleared out of the way with only 8 outlets in the 3 upper grades,—4 Deputy As-

sistant Commissaries, 2 Assistant Commissaries and 2 Deputy Commissaries. Does it not stand to reason that the higher grades must be increased considerably, as there should be some hopes for a man after 25 years' service to look forward to something substantial; and more particularly for men living in a country like this perhaps one of the dearest provinces under the British rule. And now that Burma has been increased by twice her former establishment a proportional amount of grades should be made in the warrant ranks that may give a fellow some chance in life to support him in his old age. And now I will leave the matter in your hands. If you see fit to make some comments on the matter I shall feel obliged.

MILITARY SUBORDINATE.

### HOW TO LIVE COMFORTABLY IN INDIA.

SIR,—Sometime ago you were good enough to publish an article of mine on the construction of houses in this country with double walls and roofs, the object being the comfort of the dweller in India by day and by night. After going through the last few months of unprecedented weather, some few may be inclined to build a house with a double wall, and throw two arches from the ordinary rolled iron-joist instead of one; but such a luxury could only be indulged in by the few, so I propose to call your readers' attention to the fact that a small house say, 20' x 20', raised from the ground and built—as to its walls—with mat only, and its roof of thatch—is a grand thing to sleep in at night. Up-country, in very dry latitudes, the mat walls might be replaced by open jaffrey. This would, of course, be in addition to the ordinary day habitation, and if well away from the brick oven generally used in this country, a really good sleep would be obtainable in any weather. The framing of the bungalow—a mat one—in which I now live, is made of old iron-rails, but sāl posts or other good timber would answer just as well. My advice would be:—Raise the house on piles, or by earthwork, well above ground level and make a waterproof floor with a mat construction on top. The amount of heat absorbed by the matting is given off in half an hour. Not so the thick brick wall, which invites heat all day and ejects it all night inwards and outwards. A verandah all round the above mentioned 20' x 20' room protected by jaffrey would allow of one's sleeping with all doors and windows open, and without fear of jackals, &c. Having permanent open jaffrey windows on one side, would necessitate the making of only sufficient verandah to protect the open door.

No—SAM.

Our Correspondent's suggestion is virtually the custom of the country in Burma.—ED., I. E.]

### SIND-PISHIN RAILWAY.

#### III.

SIR,—In continuation of my last remarks, I may add that the main junction station had one loop-siding only, no ashpits, examining pits, engine shed, water tanks (permanent), staff quarters for Loco. or sidings.

Gulistan terminus had no sidings whatever, not even a loop, no station, no platform, no ashpits, only a temporary water tank on sleepers; while Killa Abdulla terminus was merely one loop-siding on a waterless plain. No engine could stand there at all, there were no buildings of any sort or kind.

The Gulistan-Killa Abdulla section was without its bridging, culverts, ballast, buildings, signals or watering arrangements.

If two rails laid on a rough bank constitute a "practically complete" line to compare with the E. I. R., or the Ceylon line, well and good; I must assent to the term and wonder. But if not what is to be thought of the information supplied to *Engineering*?

But after all, if the line, costing as it has over Rx. 24,000 per mile had been efficient, little would have been said, but when the carrying power is found to be, owing to sharp curves and heavy grades needlessly combined, only about 60 per cent of the calculated power, the Indian taxpayer has every reason for complaint. This is the real *crux*. For reasons which are obvious I will not go into the carrying power of this Railway, the imperfection of which necessitates the retention of the Bolan temporary line.

I have now finished an ungracious and irksome task. I do not know General Sir James Browne, R.E., K.C.S.I. I have absolutely no personal feeling in the matter. *Palmarum qui meruit ferat* is my motto; whether R.E. or C.E. carried out any given work is indifferent to me.

But when a work which is conspicuously full of technical shortcomings, which has confessedly been made by amateur railway Engineers, which is enormously expensive and which, when all is said and done, very imperfectly fulfils its *raison d'être*, is held up in the face of experienced Railway men as the very acmé and model of railway Engineering, and when they shrewdly suspect that puffery of this kind is to be made the stepping stone to



further honors and emoluments for those who already have influence enough at head-quarters to supersede the Civilian who bears the burden and heat of the day, when further they see that the reputation of the P. W. Department is again saddled with a military Engineering blunder, the most important of all professional feelings, that of pride in good work is outraged, and criticism becomes nothing less than a duty.

I shall not refer further to this subject which has now become a question of the personal merits of the Engineer-in-Chief. I repeat that I wish General Sir James Browne every success. I appreciate the energy and natural ability which enabled the R.E. staff to make a line which would work at all. I admire the courage which kept them at their posts in a climate so trying and among natives so ferocious. I grudge them none of the praise and rewards which *esprit de corps* gives them, but I cannot permit the Sind-Pishin Railway to be upheld as one of the greatest Engineering triumphs of the age.

VERITAS.

### BANGALORE WATER-SUPPLY SCHEME.

SIR,—The *Bangalore Post* devoted two rather irate leaders to the consideration of the Water-Supply of that town. The editor clearly aspires to profound Engineering knowledge and, maybe, also to Engineering honors, and tries to achieve this by championing in no measured way what is known as General Fischer's Hebbal Scheme. It will be recollected that your Madras scribe took the extreme liberty of analyzing this project in a very rough and ready way, and by applying well-known Engineering data to it, showed how vain were its aspirations as the only source of supplying the town of Bangalore with water. Your correspondent is contemptuously condemned by the *Daily Post* as an anonymous scribbler, and not worthy to be considered by the side of the great Fischer. This reminds me of the Volunteer Colonel, a provincial tradesman, inspecting and condemning his last recruit for want of a military spirit. When told that this recruit was a retired General so and so with a breast full of medals, the Colonel was shocked, and was very careful afterwards always to enquire the names of his recruits before condemning them. A General of Engineers I must admit makes a very handsome figurehead, and looks very imposing with his name at the top or bottom of any scheme, but when thrown on his own resources, without subordinates to command, and on the very rough road of an open competition, who will blame the old man if he is found to limp a little, and is left behind by younger and stronger men. No one will blame him, but every one will pity him, and the "pity of it is" that the *Bangalore Daily Post* cannot see this, but goes hammering on at a foregone conclusion.

The principal objection is to the co-efficient of storage being taken at .075 of rainfall. This was ascertained after very careful experiments extending over several years made at the Ulsoor and Sankey's reservoirs in the near vicinity of Bangalore. The average given by Molesworth for the whole of India, including the snows of Himalaya and the perennial outflow of Cauvery, is preferred! What will our latest Knight say to this application of his averages? We should not be surprised if he obliterated them from the next edition of his book.

Another vital objection to the Bangalore data is that they were recorded by natives. Does the *Bangalore Post* understand what abstruse mental and philosophical calculations have to be made before recording the figures on a gauge? Is it more difficult than driving a carriage, sweeping a room, or even brushing the cobwebs off an editor's eyes? Verily it is an argument of "Hit him hard he has no friends" and when meanly resorted to, shows a very lame, poor case indeed.

The last objection which I will notice is that the co-efficient was drawn from such small areas as that of the "Ulsoor tank with its 2'4 of drainage area and Sankey reservoir with much less." Perhaps the *Daily Post* has not seen Dickens's formula for the North of India and Rives's for the South, or any of the other numerous Engineering formulæ used in calculating available rainfall from catchment grounds. If he had seen these formulæ he would have known that the larger the area the less the proportionate rainfall available for storage, and therefore the less the co-efficient of reduction. If .075 was found to be the proportion of available rainfall at Ulsoor then a smaller and not a larger proportion will be available at Hebbal. These are Engineering inductions that cannot be overridden by mere talk. If the Hebbal gathering ground has been well trodden on like parts of a city or town, it may not be so absorbant, or if it is well drained like the gardens and roads of Bangalore with side and cross drains, it may not require so low a co-efficient, but so long as the conditions of the Hebbal and Ulsoor drainage areas are alike, and Hebbal is larger than Ulsoor, the proportionate available rainfall at Hebbal will be less than that at Ulsoor, and it will require a smaller co-efficient.

I would seriously urge the *Daily Post* to forego its aspirations as an Engineer and leave the knotty question of the Bangalore water-supply to better trained minds.

ONE WHO KNOWS.

## Literary Notices.

DIAGRAMS OF SCANTLINGS, ROLLED IRON BEAMS, WATER VELOCITIES FOR ENGINEERS AND ESTIMATORS. By J. E. Hilton, M.I.C.E., Executive Engineer, P. W. D., India. Lahore: Ball and Co. 1888.

ANY collection of notes and information of a technical character, provided it is put together in a form convenient for use and easy of reference, is always welcomed by the Engineering profession; and if such information is arranged so as to be available at a glance it is welcomed all the more.

Of late the method of placing facts and figures in diagrammatic form has become popular—being found to offer great facilities for reference, and not only is time economized, but the liability to serious error is reduced by having recourse to these graphic methods. It is for this reason that the small book of 8 diagrams prepared by Mr. J. E. Hilton, of the Punjab P. W. D., is most acceptable and should find a place wherever the information offered in his book of diagrams is constantly wanted, i.e., in all Engineers' offices. It is better for those not versed in figures and formulæ, viz., draftsmen and subordinates, to rely on these diagrams—to be sure and quick with their work; and for Engineers themselves it is an advantage to have results of formulæ "cut and dried" within arm's length.

The advantages Mr. Hilton claims cannot but be conceded: he says the diagrams avoid the labor of calculation and the risk of error in calculating, and shew in a compact form not only what section of material, what waterway, &c., is required to fulfil certain conditions, but the converse also.

The diagrams are compiled for wooden kurries, joists, &c., wooden beams, rolled iron joists, principals of pent roofs, velocity of water in plastered and ordinary channels for bridging, flood discharges, and discharges in pipes. The results for wood are given for teak, sal and deodar. Each diagram is accompanied by particulars of the problem; the formula used in preparing the diagram is also noted and an example worked out.

The get-up of the book is good, its printing neat, and its price moderate.

## New Books and Reprints.

### ENGINEERING AND MECHANICS.

- COOPER (J. H.) A Treatise on the Use of Belting for the Transmission of Power. 3rd ed., with Appendix, bringing the Subject fully to the Present Time. 8vo, pp. 400. Philadelphia ... 18/  
 GILLMORE (Q. A.) Notes on the Compressive Resistance of Freestone, Brick, Piers, Hydraulic Cements, Mortars and Concretes. 8vo, pp. 198. New York ... 15/  
 KNIGHT (Cameron) The Mechanician: A Treatise on the Construction and Manipulation of Tools for the Use and Instruction of Young Engineers and Scientific Amateurs. 4th ed. 4to. Spons ... 18/  
 MONCKTON (J. H.) Stair-Building in its Various Forms and the New One-plane Method of Hand-Railing; as applied to Drawing Face Moulds, Unfolding the Central Line of Wreaths, and giving Length of Balusters under all Wreaths. 4to. New York ... 25/  
 PORTER (Charles T.) A Treatise on the Richards Steam Engine Indicator. 4th ed., revised and enlarged. 8vo, pp. 270. Spons 9/  
 THURSTON (R. H.) A Manual of Steam-Boilers; their Designs, Construction and Operation. For Technical Schools and Engineers. Illust. 8vo, pp. 677. New York ... 25/  
 WEGMANN (E.) The Design and Construction of Masonry Dams; Giving the Method Employed in Determining the Profile of the Quaker Bridge Dam. Illustrated by Types, showing the High Masonry Dams of the World. 4to. New York ... 25/

### ASTRONOMY.

- JEANS (H. W.) Hand-book for the Stars, 4th ed. Revised by Staff Commander W. R. Martin. Roy. 8vo. Longmans ... 5/  
 LOCKYER (J. Norman) Elementary Lessons in Astronomy New ed. 12mo, pp. 376. Macmillan ... 5-6  
 MARVELS of Astronomy, Including a Popular Account of the Solar System, Modes of Computing Time, the Seasons, the Planets and their Satellites, Comets, the Sun, the Moon, Eclipses, Double Stars, Colours of Stars, the Constellations, and the Milky Way, together with Many Modern Astronomical Appliances. With many Illustrations (Scientific Recreative Series) Post 8vo, ed., pp. 156. Ward and Lock ... 1/



## General Articles.

### THE SEWERAGE OF THE FORT OF MYSORE.

BY STANDISH LEE,

Sanitary Engineer, Mysore State.

#### IV.

#### FLOOD-WATER DRAINAGE.

IN the foregoing scheme, the removal of soiled water alone has hitherto been discussed. It is, therefore, necessary to show what is to become of flood-waters. On plate X. will be found lines of covered masonry drains built at the beginning of the century by Purniah. An inspection of the map and sections will also disclose the fact that they were built on some system, and that the sections given them were ample for the discharge of very heavy falls of rain, as proved by calculations. The cross sections on plates XI. and XII.

While the extent to which they have silted up is proof of the correctness of the views expressed by me in my preliminary report, *viz.*, that sewers constructed out of all proportion to the ordinary work required of them, cannot maintain a current to keep them clear of silt, and, therefore, become sewers of deposit; it is also an evidence against the immobility of an unsuspecting municipality, when that authority is content to allow such dangerous cess-pools,—recently described, by a Sanitary authority as, “Cauldrons engaged perpetually, night and day, in the unholy work of distilling poisonous gases for the injury and dispoilment of mankind,”—to exist in an important and populous centre such as the Fort, without any attempt at cleaning them for years past.

These drains are, as a whole, in a fair state of preservation, so far as the inspections have gone. They simply require to be cleaned out,—which is not estimated for as being an ordinary Municipal work,—plastered on the inside, and silt pits constructed at the points marked S. P. on the map. Most of the drains are built with man-holes, and some few have even silt-traps, and, therefore, at a very small outlay, they can be adapted to the satisfactory removal of all rain-water. The floors are, however, very much broken up, but will not affect the removal of storm water. An approximate estimate of cost of the works required is furnished later on, but it is simply an approximation, as nothing approaching correctness can be arrived at until all the silt is removed.

They debouch at three points, *viz.*, on the west, at D. (plate X.) near the west gate; on the north, at B; and on the south, at C; which is also the present outlet for sewage. It is proposed to continue this arrangement of three points of discharge, as rain water at these point will do no harm.

Seeing that these drains are, on the whole, very complete, it may occur to some of the Municipal Commissioners that they might, with advantage, be adopted for carrying off sewage as well, by having their floors relaid in concrete with a channel down the centre, the size of the proposed pipe sewers. It is therefore necessary to explain the dangers attending such a course. First:—They are not laid at a sufficient incline to give the velocity necessary to prevent deposit, and to carry off the sewage before fermentation sets in. Secondly:—The length of these drains being 5,700 feet, and the amount of air space contained within them 35,000 c. ft., exhalations from the sewage—which will be stagnant from want of sufficient fall—to the extent of the cubic contents of these drains, will, therefore, be constantly stored in them within the habited area of a densely crowded locality, and thus destroy the primary object of sewerage works.

(To be continued.)

## NOTES ON NAVIGATION.

By A. EWBANK.

### I.

IN some previous articles on various subjects, of which those on the oblique arch may be mentioned as an example, we addressed ourselves specially to Engineers. In the study of the bee-cell we wrote for naturalists. In the articles on “Drift” we wrote for gunners. In the present articles which, like the former, contain original matter, we write especially for sailors.

These articles are not intended as a substitute for any nautical text-book now in use. Such text-books properly lay stress rather on methods for working navigation problems than on the reasons or principles that underlie the methods. At sea what we require is accuracy and rapidity. Accordingly in practice everything is reduced, as far as possible, to the consulting of printed tables.

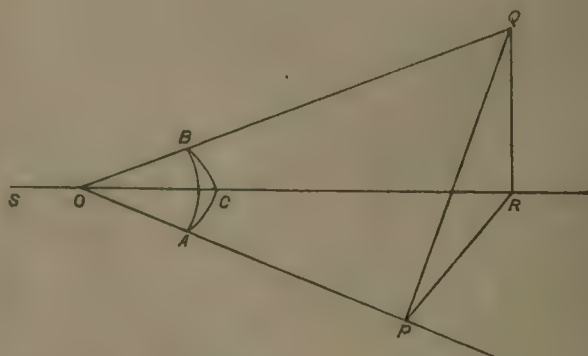
There is, however, among ships' officers a minority who are able and anxious to understand something of the theory of which navigation rules constitute the application. The present articles go some way—though a very little way—to satisfy these desires. In these investigations we shall use a little spherical trigonometry and a little of the differential and integral calculus. Our spherical trigonometry formulæ will, for convenience, be worked out and collected at once. Our applications of the calculus will be clearly indicated, so that a very elementary knowledge of it will enable the reader to follow the reasonings. We shall refer to the calculus only as we need it.

In spherical trigonometry we shall merely have to deal with those triangles that contain at least one right angle. The other two angles will generally be acute, though in particular cases one of these will also become a right angle.

We must draw our figures on a plane, *viz.*, the plane of the printed paper. But we recommend the reader always to copy the figure under consideration on to a sphere. A cricket or tennis ball will answer the purpose. Or a wooden ball is easily made and is very useful.

The three angles of a spherical triangle are always greater than two right angles. If the triangle has those two sides equal that make the right angle, the other angles will be equal, but they will not be  $45^\circ$ . They may be  $50^\circ$  or  $60^\circ$  or  $90^\circ$ , or even both obtuse. But we shall only have to deal with acute angles in our investigations.

Fig. 1.



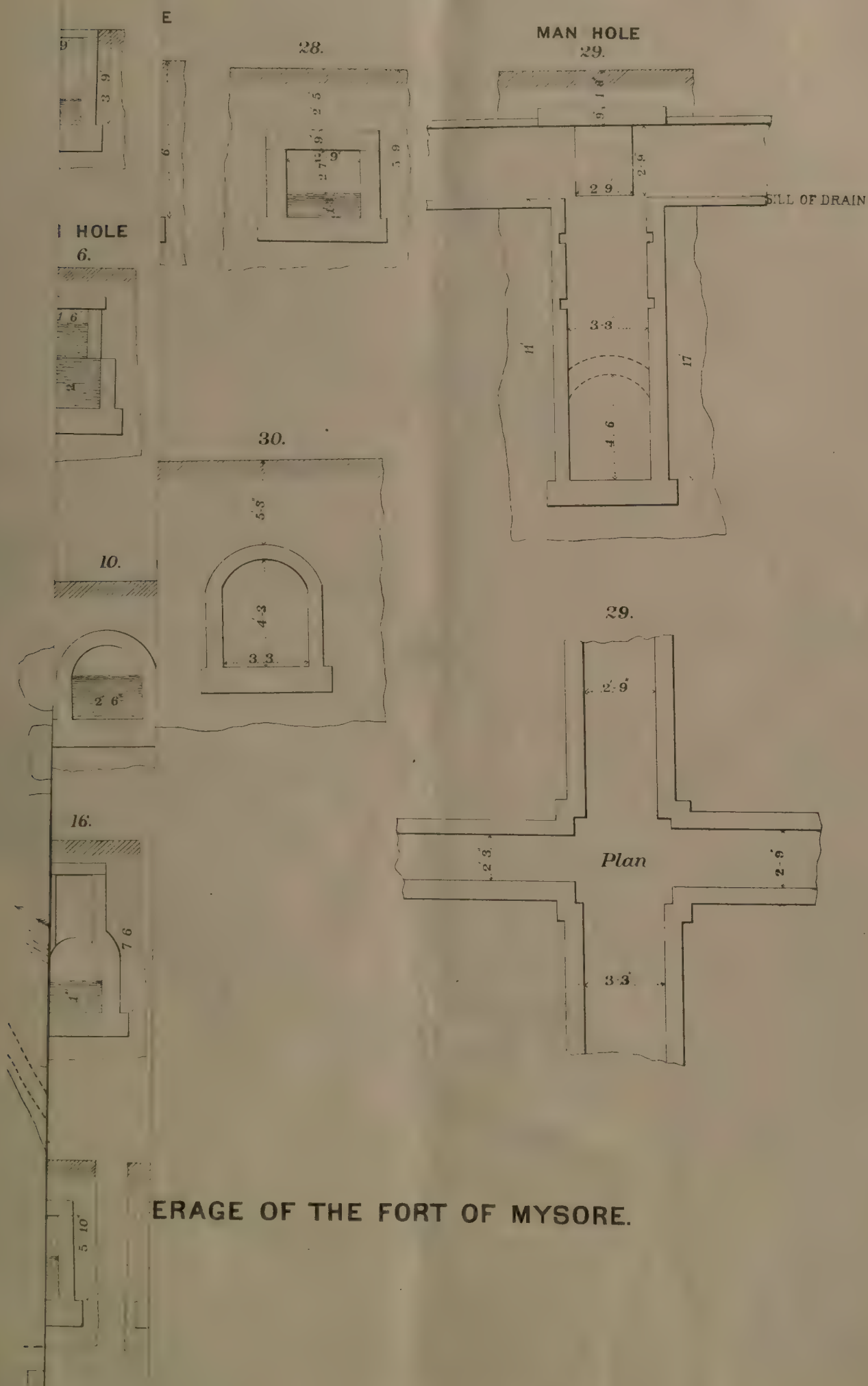
In fig. 1 we have two planes which meet in the line R S. Q is any point in one plane R S Q, but Q is supposed to be not on R S. If the plane Q R S meets the other plane P R S at an acute angle, and if we draw from Q a normal, *i.e.*, a perpendicular, to the plane P R S, this normal will not meet the line R S. If, however, the given planes do meet at right angles, then the normal must meet R S. We suppose the planes at right angles. We therefore draw Q R normal to S R and also normal to the plane P S R. In R S take any point O different from R. Thus Q O R is an acute angle. Draw O P in the plane P R S so that P O R is acute. From R and in the plane



CROSS SECTIONS OF EXISTING  
COVERED-DRAINS FOR CARRYING AWAY RAIN-FALL.

OVERED-DI

S. 5' = 1'









R P S draw R P normal to O P. This defines the point P. Join Q P. This line does not intersect R S. We have

$$\begin{aligned} O Q^2 &= O R^2 + R Q^2 \\ &= O P^2 + P R^2 + R Q^2 \\ &= O P^2 + P Q^2 \end{aligned}$$

Thus O P Q is a right angle. Therefore R P Q is the angle between the plane R S P and the new plane Q O P. The three planes R S P, R S Q and P O Q may be called the planes R O P, R O Q and P O Q. They all meet at O and each two gives a line of intersection passing through O.

With O as centre and any radius draw a sphere. The three lines of intersection meet this sphere in the points A B C. The three planes P O R, R O Q, Q O P give great circles on the sphere, and in the figure we have A C, C B and B A as arcs of these circles respectively.

The angle A of the spherical triangle A B C means the angle between the planes A C O and A B O. This angle A = R P Q. The angle C or B C A is the angle between the planes P O R and Q O R. This angle is a right angle. This angle C is not properly shewn by Q R P, because R P is not normal to R S. As a matter of fact, C = Q R P because, Q R P happens to be a right angle. But we cannot conclude that the angle B of the spherical triangle is equal to the angle P Q R.

In order properly to exhibit the angle B, we should draw two lines from Q respectively in the planes O Q P and O Q R and each normal to O Q. This angle B is also the angle between the two tangent lines at B to the two circles B C and B A. This is in fact the natural way to understand what is meant by a certain acute angle between two great circles on a sphere.

The sides of the spherical triangle we may call  $a, b, c$  as in plane trigonometry. Only by  $c$  we mean the angle P O Q or A O B and not the arc A B as measured in miles.

$$\begin{aligned} \text{Thus } \sin a &= \frac{Q R}{Q O} \\ &= \frac{Q R}{Q P} \cdot \frac{Q P}{Q O} \\ &= \sin A \cdot \sin c \end{aligned} \quad (1)$$

By modifying the fig. (1), or by reasoning from analogy, we may conclude that

$$\sin b = \sin B \sin c$$

This is not really a new equation. It is only (1) in duplicate. For in (1) A means either of the acute angles of a spherical triangle. In future, therefore, such duplicates may be omitted.

$$\begin{aligned} \tan a &= \frac{Q R}{R O} \\ &= \frac{Q R}{R P} \cdot \frac{R P}{R O} \\ &= \tan A \cdot \sin b. \end{aligned} \quad (2)$$

$$\begin{aligned} \cos c &= \frac{O P}{O Q} \\ &= \frac{O P}{O R} \cdot \frac{O R}{O Q} \\ &= \cos b \cdot \cos a \end{aligned} \quad (3)$$

This equation corresponds to the formula in plane Geometry

$$c^2 = a^2 + b^2.$$

$$\begin{aligned} \text{From (2)} \quad \cot A &= \sin b \cot a \\ \text{Similarly} \quad \cot B &= \sin a \cot b \\ \therefore \cot A \cot B &= \cos a \cos b \\ &= \cos c \end{aligned} \quad (4)$$

$$\text{By (1)} \quad \sin A = \frac{\sin a}{\sin c}$$

$$\text{By (2)} \quad \cot A = \sin b \cot a$$

Multiply these together, thus:

$$\begin{aligned} \cos A &= \cos a \frac{\sin b}{\sin c} \\ \text{and } \frac{\sin b}{\sin c} &= \sin B \quad \text{by} \end{aligned} \quad (1)$$

$$\therefore \cos A = \cos a \sin B \quad (5)$$

$$\begin{aligned} \text{Finally} \quad \tan b &= \frac{R P}{P O} \\ &= \frac{R P}{P Q} \cdot \frac{P Q}{P O} \\ &= \cos A \tan a. \end{aligned} \quad (6)$$

To these six relations we shall continually refer, and accordingly they have been supplied with reference numbers.

### TRIAL BORING FOR AN ARTESIAN WELL IN THE BASIN OF THE CORTILYAR RIVER, MADRAS.

FOUR years ago, a boring was made under the superintendence of Mr. L. Cornet in the Peoples' Park of Madras, for the purpose of ascertaining the possibility of finding some ascending water as it is the case in the basin of the Yengee river at Pondicherry.

Although an outcrop of gneiss six miles south of Madras should have caused the doubt that a boring would not be attended with success, and would likely meet the primary rocks, a trial, however, was undertaken, and came in contact with the gneiss at about 65 feet below the ground, thus demonstrating that the geological formation of the Couam's basin, was not promising for undertaking artesian wells.

This, however, was known before hand, by the several borings executed in Rayapooram, Tondiarpett, and Trivatore; but all these borings shewed that the gneiss outcropping at St. Thomé was dipping northwards, and was underlying the basin of the Cortilyar probably to a great depth.

An artesian well bored at Ennore, near the outlet of the Cortilyar into the sea, and twelve miles north of Madras, reached a depth of 112 feet without meeting the primary rocks, and it appears that at this depth an ascending water sheet rose into the pipe above the level of the river.

Such result was considered as promising, and Government ordered that some trial borings should be made in the Cortilyar valley with the view of improving the water-supply of Madras, and also for ascertaining, at the desire of the Geological Survey, the nature of the alluvium deposited in what they considered as the old bed of the Palar. The Geological Survey being of opinion that this valley of the Cortilyar was likely in an underground communication with the former river.

If such was the case, it was reasonable to suppose that a boring made in the alluvial basin might tap some ascending water-sheet issuing from the Palar, and running underground into the alluvium; then if a trial boring was attended with success, an artesian well of a large diameter bored at the same place, would give a large supply of water which would be easily turned in the Red Hills tank.

Such were the reasons which induced Government to undertake the trial boring now in way of execution, and a contract was made for the purpose.

The locality selected is situated near the village of Karani, in the talook of Trivellore, in the centre of the Cortilyar alluvial basin, two-and-half miles below the Tambrapucum anicut, which diverts the waters of the Cortilyar into the Cholaveram and Red Hills tanks, by a canal passing through the spot where the boring was to be made.

Mr. Adrien de Closets, an Engineer of good experience in artesian well boring, having executed several wells in Pondicherry, had charge of the direction of the works. Government supplied the boring apparatus consisting in a set of sheer legs 40 feet high, a number of boring rods, a set of boring tools—such as augers, jumpers, &c.—rivetting apparatus, 200 feet of piping 8" diameter in pieces 10 feet long, also several sorts of buckets and shells, crab winches and a 4 H. P. steam engine. The apparatus was provided with a powerful arrangement for forcing down the piping which was to protect the sides of the bore hole during the work, and sundry other implements.



Sheds were erected for the Engineer in charge, and for covering the boring platform.

The works were started in the end of June 1886 with a hole of 8 inches diameter. As there was no possibility of securing skilled workmen, the villagers were trained for the purpose, and did very fairly after a few weeks' practise.

The boring at the present date has arrived at a depth of 405 feet. The following statement gives the thickness of each stratum, its nature, and the total depth at which each stratum was met with.

No. of Stratum.	NATURE OF STRATA.	Thickness of Stratum.	Total Depth.
		ft.	ft.
1	Vegetable mould, clay and sand mixed—reddish hue	4	4
2	Sand and clay mixed with kunkur, reddish yellow	3	7
3	Brown clay with kunkur	4	11
4	Sand holding water—the same as in the neighbourhood wells	3	14
5	Sand mixed with yellow clay	16	30
6	Yellow clay	10	40
7	Coarse sand similar to river sand; this stratum containing a sheet of water which rose in the pipe to the level of 7' below the ground	13	53
8	Clay, yellow and stiff, mixed with sand, pebbles nodules of grit, clay passing to whitish, and with some thin layers of grit	31	84
9	Limestone, crystallized and very hard, color yellowish	1	85
10	Yellow clay variegated with black and grey	17	102
11	Black clay (common blue clay)	6	108
12	Yellow clay variegated and similar to No. 10	6	114
13	Grey clay mixed with black clay—pyrites of iron and nodules of grit	44	158
14	Black clay with grey clay and pyrites of iron	2	160
15	Limestone 2nd bed not very hard	1	161
16	Black clay indurated hard and compact with nodules of the same	19	180
17	Grey clay compact mixed with sand	10	190
18	Limestone 3rd bed	1	191
19	Grey clay indurated with sand and grit, and nodules of black clay	10	201
20	Black clay indurated	6	207
21	Limestone 4th bed	1	208
22	Grey clay indurated	2	210
23	Black clay indurated	6	216
24	Limestone 5th bed	6	222
25	Grey sandy conglomerate	70	292
26	The same with indications of shell	20	312
27	Black clay indurated	5	317
28	Limestone 6th bed	0.50	317.50
29	Black clay indurated	2.50	320
30	Limestone 7th bed	1	321
31	Black clay indurated	27	348
32	Limestone 8th bed	1	349
33	Grey hard sandy clay with nodular pyrites of iron	2	351
34	Black clay indurated	4	355
35	Grey hard clay with pyrites of iron and debris of shells	12	367
36	Limestone 9th bed	2	369
37	Layer of grit	0.25	369.25
38	Grey hard sandy clay with kunkur decaying wood and print of leaves	1	370.25
39	Black clay with kunkur, shell, pyrites of iron, decaying wood	37.75	405
	Total depth of bore-hole	...	405

Much difficulty was experienced for enlarging the first stratum of limestone at 84 feet so as to pass the protecting pipe through it; the original hole was made with a heavy double T jumper, but the limestone was so hard, that it was necessary to adjust to the enlarging tool no less than 21 sets of bits, so as to increase the diameter of the hole from 8" to 9½", the limestone bed was only 1 foot thick, but nevertheless it required one month's work to perform the task, the bits having to be frequently changed.

The other beds of limestone were more easy to pass through with the exception, however, of Nos. 24 and 36.

When the boring reached 180 feet the black clay was of such hardness that it was considered unnecessary to lower down further the protecting pipe, consequently the boring was continued after driving lightly the pipe into the black clay, in order to prevent sand and debris passing under the pipe and falling into the bore hole below.

At the depth of 200 feet it was necessary to have the steam engine at work to assist the rising of the rods, and tilting of the rocking beam; this engine was found a very valuable adjunct.

The Cortilyar alluvium is bounded on the right and left by the tertiary formation, and by the observation of the angle at which this formation dips, to the right northwards and to the left southwards, it was presumed that the deepest point of the alluvium overlaying the tertiary formation, would be met with at 300 or 340 feet below the bed of the Cortilyar, but the boring having reached 405 feet without any indication of laterite, seems to indicate that the tertiary formation has been eroded by a powerful stream, leaving a hollow which has been filled up afterwards by the alluvium existing now.

The nature of the strata, the debris brought out by the shell from 405 feet deep, and shewing particles of organic matter, seems to indicate that (as it is the case generally in the Pondicherry borings) a hope may be entertained of finding ascending water below 405 feet, but no certitude could be relied upon; it is the boring only which could elucidate the question; and it is to be hoped that Government will not discontinue the boring unless primitive rocks are met with.

It has been said, before, that when the bore-hole reached 42 feet water rose into the pipe from 14 feet to 7 feet below the ground; this, in fact, is a very important point which is not to be lost from view. In fact, the water standing in the pipe at 7 feet below the ground is at 5 feet above the bed of the canal passing near the works, at a distance of 50 feet; besides the level of water in the pipe varies according to the season from 7 feet to 3 feet below the ground, that is, varies from 5 feet to 9 feet above the level of the bed of the canal. It will be therefore possible to utilize this water.

For instance if instead of a pipe 8" diameter a pipe of 4' or 5' diameter was inserted in the ground, the delivery of water during 24 hours will be very large. The outlet of such pipe should be made at 8 feet below the ground, so as to have an hydrostatic pressure or head of 1 foot. It is therefore easy to calculate what would be the delivery of such a pipe during 24 hours; with a head of 12". By an experiment upon the actual pipe it will be very easy to ascertain at a trifling expense what could be expected from the water sheet at 42 feet.

It is to be believed that the old bed of the Palar was there at 42 feet below the actual ground, but if the ascending water issued from the Palar by an underground communication, it would rise in the pipe at a greater level; perhaps this water is the water of the Cortilyar percolating some permeable strata higher up in the valley.

A. DE CLOSETS.

MADRAS; July 10.

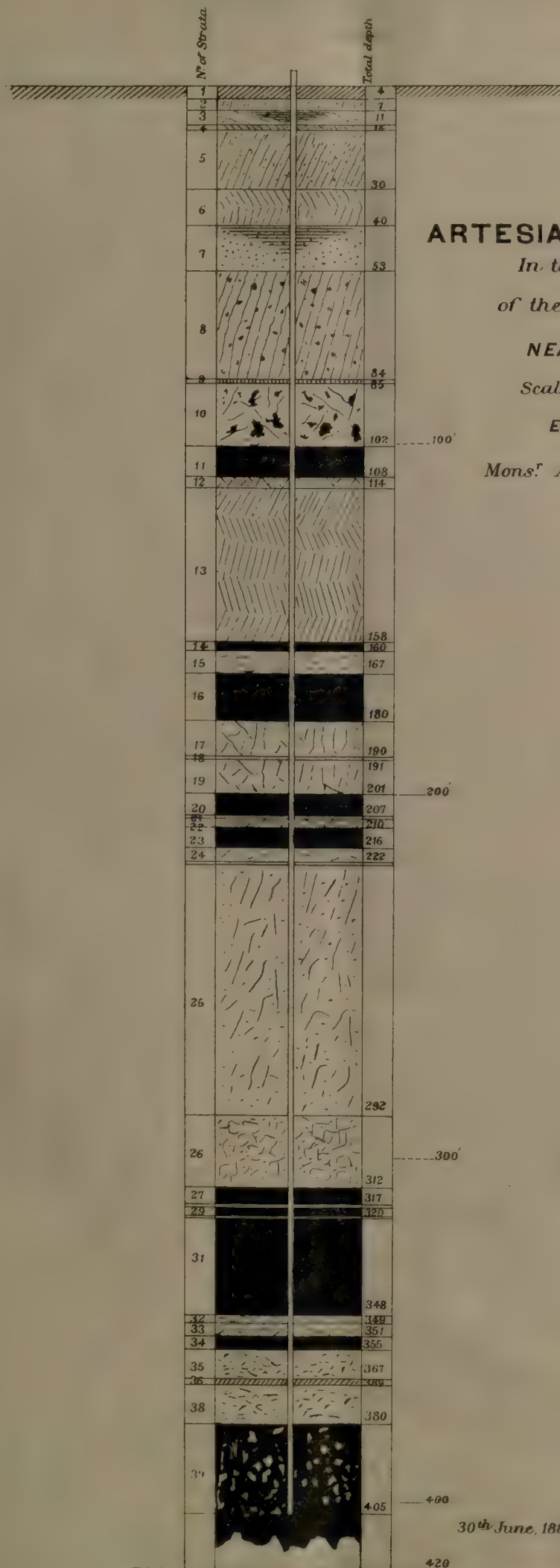
#### THE HAWKESBURY (N. S. W.) RIVER BRIDGE.

[Expressly for INDIAN ENGINEERING.]

The chain of Railway communication along the coast line of Australia is now complete between Adelaide and Brisbane with the exception of seven short links, which are represented by the seven spans of the Hawkesbury River Bridge, about 30 miles distant by Railway from Sydney. At noon on Friday, 25th May, the first of these links was supplied, and it is confidently hoped that before the end of this year the remaining six will be placed in position, and the bridge open for traffic, thus filling the only gap in the 2,000 miles of Coast Line Railway.

In the year 1884 the Government of N. S. W. invited tenders from the world for designs for this bridge, with the result that eventually the design furnished by the Union Bridge Co. of New York was adopted, and their tender accepted. The company relet the contract to (1) Messrs. Anderson and Ball of New York for the sinking of the caissons, (2) Mr. Louis Samuel of Sydney for the masonry work; and (3) to Messrs. Ryland and Morse of Chicago for the erection of the superstructure.





## ARTESIAN WELL BORING

*In the Basin*

*of the CORTILYAR Riv<sup>r</sup>.*

**NEAR MADRAS.**

*Scale 40' to 1 inch.*

**ENGINEER**

*Mons.<sup>r</sup> Adrien de Closets.*

30<sup>th</sup> June, 1888







The completed bridge will be of a total length of 2,896 feet between the abutments, in seven spans; the two spans at the abutments being of 408 feet, and the five central spans of 416 feet, 30 feet in width, and each span weighing about 1,000 tons. The bridge is to have a clear headway above high water of 41 feet and to carry a double line of Railway 4 feet 8½ inches gauge. The total amount of the contract, including extras, being £367,000. There are several features of marked interest to the Engineering profession in the construction of this bridge, notably the ingenious manner in which the first huge span was placed in position.

The spans are being built upon a pontoon moored at Dangar Island, and distant about 4,000 feet from the spot where the first span was to be placed. Each span is somewhat of the form of an epicycloid, the maximum ordinate being about 60 feet in height. The great feature of the bridge is the pin connections, and there is no rivetting of any consequence. By this means it is claimed that greater play is given to the bridge, the strain is more general, and with a free use of eyebars great strength is afforded without a superfluity of iron. Unlike bridges of English make, the heaviest iron is on the top, the greatest stress being chiefly on these; some parts weighing as much as 12 tons having been used in the construction, and successfully hoisted into position, a distance of 110 feet.

The construction of the pontoon upon which the spans are being built is quite an Engineering feat in itself. The pontoon is 635 feet long, 61 feet broad and 10 feet deep and is of a tonnage equal to that of first-class ocean-going mail steamers, viz., 7,000 tons. It is built in water-tight compartments, connected by valves. Until the 25th May it had lain upon skids, so as to keep an even bottom; the skids resting upon a sunken rock, during which time these valves were open, and the water flowed in and out freely.

At extremely low tides the valves are closed after the water has drained out. The object of this is to obtain automatic action, so that the pontoon could be made to rise or sink by the letting in or out of water. Upon the deck, trestling was erected 35 feet high, along which were two lines of rails for the use of a "traveller" which was 75 feet high, 65 feet long and 57 feet wide. The span was put together on these trestles, as it would have been impossible to have raised it as a whole structure.

On the top of each pier of the bridge are two pedestals which are bolted into the stonework. There are two shoe plates on each end of the iron-work of the span which fit into the pedestals. These are then bolted and become permanently fixed.

The span having been completely finished upon the trestles built on the pontoon, the great problem was how to get the unwieldy mass into position, and the span securely placed upon its beds. This great feat was happily most successfully carried out, and the span now rests where it will probably remain for all time.

Everything being in readiness to launch the span, it was decided that this critical work should be done on the morning tide. The men were out at 6-30 bestowing the line by which the pontoon with its great charge was to be towed over. This line consisted of a Manila hawser 4,000 feet long. One end of the line was fixed on a masonry pier, and the other end by two or three turns over a steam winch on the pontoon, and then to an engine on the island. At 7 o'clock the punt was floated off, and at 10-30 it was in position between the piers, the ends of the span being just above the piers upon which they were destined to rest as soon as the tide fell. The pontoon was found to be much more manageable than was anticipated, and with the free use of anchors, and with the aid of small steamers, it was without any great trouble brought into the proper position between the piers. At 11-45 A.M. the tide had gone down sufficiently to enable the span to settle on the piers. The position had been calculated to a great nicety, the shore plates in the spans, and of which there are two at each end, fitting properly in the pedes-

tals on the stonework of the piers. The tide went down very slowly, and it was not until 2 o'clock that the pontoon was got away from under the span. In two minutes it was 100 feet off, owing to the strong tide running at the time, and by 3 o'clock it had been safely brought back to Dangar Island to be used for the erection of another span. The span, after the removal of the pontoon, seemed to be resting in mid air, its tapering ends appearing to hardly touch the piers upon which it was in reality supported. In position the span seemed to be remarkably light, but this was owing to the great height of the ironwork above the river.

The task of building another iron span has been already commenced, and as, with the experience already gained, there will not probably be any delays; it is hoped there will be another launching in about a month's time. The stone masonry will be finished in about three weeks' time, when all the piers will have been completed, and if all goes well, the bridge will be so far finished that trains can pass over it by the end of the year.

The enterprise, courage, forethought and ingenuity of the designers and contractors undoubtedly merit all the success by which their efforts have been attended, and they have great cause to be proud of the successful accomplishment of one of the most difficult Engineering feats of modern times.

MANFIELD NEWTON.

#### FOREIGN VERSUS LOCAL INDUSTRIES IN BURMA.

WHEREVER Trades or Industries have suffered by the British policy of "Free Trade," there is no part in the East has so much suffered during the late depression—which so long overhung the commercial world—than Burma; in fact, in no part in the East does the foreign commercial element predominate than the rising city of Rangoon; and the consequence is, that a great deal of our industries have been probably worked at little or no profit. Notwithstanding Government encouragement, remission of dues, free duty in exporting, &c., still there is no perceptible inclination for an improvement.

So much has been said and written about foreign competition and its effect on local production, that it has become necessary to endeavour to sum up the whole of disjointed assertions, that have been furnished for the instruction of the commercial world, chiefly by those whose contributions to the solution of the question, rather than edifying exhibit the ill-effects to those interested. We have no desire to deal harshly with those who have so precipitately rushed into print, and indeed grant there is a substratum of truth underlying the mass of facts that have been detailed in the columns of a Rangoon paper. But after carefully weighing the whole of the evidence adduced, the only conclusion we can arrive at is, that what is new is not true, and what is true is not new, at least to anyone who has studied the question even superficially. From the statements made by detractors of Burmese industries and the host of Trade Returns, we learn that our industries have deteriorated in quality of material, in workmanship, and that they cannot be supplied so cheaply as our foreign competitors; in fact, that our manufacturers do not exhibit the amount of energy and enterprise displayed by their foreign competitors. To all of these we must give an emphatic denial. Anyone who has visited the recent Exhibitions (both British and foreign) must admit that at no time in the industrial history of Burma, did our manufactures exhibit such excellence and true workmanship, as at the present time, under the fostering care of Government. We are afraid that some of the writers must have based their assertions upon the fallacy, that since the collapse of the late King's reign, that the national industries of the country have deteriorated. While willing to admit that imitation is the sincerest flattery, our manufacturers very reasonably object to be judged by the imitation of foreign manufactures; in fact, spurious imitations are becoming so notorious, that the industry in hand-made silks of this country is falling off, owing to the cheap German importations. As to the question of price, there is undoubtedly an amount of truth, at all events with reference to certain articles. That we can expect to be able to make everything cheaper than other competitors, is out of the question. Cer-



tain places have such exceptional natural advantages for the manufacture of certain articles, that it is impossible for places less favorably situated to compete. And it is quite easy to see that these physical advantages may be so widely spread that there becomes an abundance of skilled labor, and an opportunity of obtaining and employing complicated machinery which in less favored countries could not be done. The places less favorably situated may, for various reasons, hold the market for a time, but in the natural course of things, and the development of inter-communication, sooner or later causes an article to be produced in the place most suited for its production. This is a process that has been going on through all time, and is only a little more prominent during bad times. A further element in the question of cost is wages, and it is one requiring most careful consideration, there being anything but unanimity as to whether high-waged men or low-waged men are the cheaper. In articles in which there is much hand work, the cheap foreign productions preclude competition, but where highly skilled labor is required, the cheaper foreign importations do not appear to advantage. In fact, looking at the staple industries, it is quite possible to compete as long as the same skill, energy and enterprise is displayed, and ready markets found for local productions. No better instance can be quoted of the excellence of the Burman industries, than the samples sent to the Glasgow Exhibition, by which means a number of orders were obtained, but strange to say that similar specimens retailed locally do not appear to much advantage alongside of cheap and spurious German imitations, and the only way of solving the secret will be to restrict foreign imitations,—then only will the indigenous industries of this country improve in every respect.

H. T.

#### NOTES FROM HOME.

(From our own Correspondent.)

M. DE LESSEPS has not been successful in raising his loan for the Panama Canal. One million three hundred thousand, out of a total of two million lottery obligations offered, are all that has been subscribed. This too after weeks of hard work, every means possible having been resorted to to puff the loan. A subscriber for a bond of 360 francs was to receive back 400 francs and until his bond was drawn for repayment was to enjoy an income of 15 francs per annum on his investment. Beyond this, lottery prizes are offered, three in each year of £20,000, three of £10,000 and six of £4,000, besides several prizes of smaller sums, for which drawings were to be held every two months. These tempting offers notwithstanding, the loan has been a failure. One of two things now seem to be inevitable, either to stop paying interest on shares and obligations, or to stop the works; money for both being no longer procurable. It is stated that the dead weight on the company, apart altogether from the expense on the works, will now exceed four million pounds per annum. The money now available for the works and interest payments will, it is said, barely last till this time next year. Reports of the death of M. De Lesseps have been recently current, but no authenticated statement of the same has yet been published.

For the fourth time the House of Commons by a very decisive majority has declined to authorize the construction of the Channel Tunnel. Considerable interest attached to the debate on the second reading of the Bill, which asked for sanction for the completion of the experimental works which of necessity were to have been enlarged into the Tunnel proper. As Mr. Gladstone's government opposed the measure 6 years ago, the ex-Premier justified his change of front by declaring that the political and military dangers which caused the opposition then were a mere "bugbear." The daily press is fairly unanimous in condemning the scheme. The *Standard* says that under the circumstances none but mad men would think of voluntarily throwing away the one natural defence which to some extent makes up for all our deficiencies, and excuses our military weakness which otherwise would be indefensible. The *Engineer* says it is merely a waste of space in describing a scheme of which no more, it is reasonable to expect, will be heard for many years to come.

Mr. Edison has perfected a phonograph which was exhibited last month before the New York Electrical Club, when the recorded conversations of various well known people were reproduced, and their voices were instantly recognised by the hearers. "Phonograms" have now been sent across the Atlantic and the voice of the sender reproduced in a London

drawing-room so exactly, that without any hint being given the audience at once recognised the familiar voice.

In consequence of opening the new Bridge over the Seine at Boulogne, the Northern Railway of France has reduced the distance between Calais and Paris, and consequently the service between London and Paris has been accelerated 20 minutes each way.

It is not yet decided whether the steamship *Great Eastern* is to be broken up. It is even suggested, if she can be docked, that after she is dismantled she should be fitted up with new machinery with a view to her employment in the cattle trade, and it is also believed that the great vessel could be profitable in the carriage of petroleum in bulk.

Professor Ewing lately delivered a lecture at the Royal Institution upon "Earthquakes and how to measure them." The lecturer referred to what has been done in Japan where earthquakes are frequent and where the chair of seismography in the University is known as the "rocking chair." The lecturer then examined the plans that had been adopted to learn the theory of earthquakes, and described the horizontal pendulum seismograph, the principle of which may be compared to a gate swinging on its vertical hinges with the hinges made to give as little friction as possible, and the electrical seismoscope made somewhat on this principle. A movement of the earth of  $1\frac{1}{2}$  inches is the largest yet recorded by the instruments in Japan, usually the motions are but a small fraction of a millimetre. By means of the Duplex pendulum seismograph the author had lately measured the shaking of the Tay Bridge at the centre of its longest span and the maximum vibration when the train was passing over it was less than  $\frac{1}{8}$  inch. The seismograph gave indications when the train began its course upon the bridge, a distance of  $1\frac{1}{2}$  miles from the instrument.

An invention for oiling the sea has just been purchased by the North German Lloyd Company. The machinery consists of a rocket to which is attached a cylinder filled with oil. It is said that the rocket can be fired accurately from the ship, and that when it explodes, the oil is scattered just where it is wanted. In an experiment recently tried at New York, rockets were fired from 1,200 to 1,500 feet from the ship and a space of from 1,500 to 2,000 square feet of water was covered with oil.

The members of the Society of Engineers lately paid a visit to the Tower Bridge works, where they inspected the northern approach and the construction inside the caissons, which are now nearly up to high water level.

Amongst the papers set down for reading at the approaching Conference of the Municipal Engineers to be held in London in July, is one upon the purification of sewage by electricity by Mr. Webster, F.C.S., the patentee of the process. The subject will offer a large fund for discussion, and as it will receive from this meeting of experts a close attention and criticism, it will be watched with interest by all sanitarians, and if it deserves the merits claimed for the process, very important results from what may be termed a revolution in this great sanitary question will no doubt arise.

#### NOTES FROM SINGARENI.

(From our own Correspondent.)

It may be said that all operations, physical as well as mental, have a crisis, and through such a phase of its existence the Singareni Coal Mine has lately passed.

The locality of this mine is about fourteen miles east of the main line from Secunderabad to Bezvadi, which latter place provides an outlet by the Buckingham Canal to Coconada, Masulipatam, Madras and other ports requiring coal on that coast. It is entirely isolated in dense forest land and far away from all centres of industry and available mining labor. In the latter part of April a batch of in-coming Railway coolies brought in several men infected with cholera, which, despite the most prompt and vigorous action of the medical supervision, spread rapidly amongst the colliery work-people. So great was the panic that in ten or fifteen days nearly all the coolies fled, and mining operations were all but suspended. At one time a suggestion to cease work was seriously considered. A peculiarity of the epidemic was, that not a single coal cutter died, the fatalities being confined to outside coolies.

Towards the middle of May the contagion declined and



some confidence was restored. At the end of the same month arrangements were made with a Hyderabad capitalist of some note in commercial enterprises, to take the whole of the coal getting and raising by contract. In a few days the benefit of the agreement became apparent and coolie labor poured into the village from all points of the compass. Later on skilled coal cutters came in from distant points, and the result in June was an output equalling any previous two months, and so far in July the improvement continues. Considering the difficulties of the present management, who in January found a crude suggestion of a colliery with a decreasing output, the advance is highly creditable. Reconstruction is frequently as serious an undertaking as initiatory action, and none but those connected with such a necessity have the remotest conception of the anxiety, the daily care and onerous responsibility of such an enterprise.

An extremely large and handsome workshop has been erected, and machines embracing almost every description used in extensive engine building establishments have arrived and are ready for placement. When completed the resources of the workshop will be the most comprehensive of any similar colliery department in India. It need scarcely be said that such a near approach to the perfection of mechanical appliances is demanded by the great distance of the mines from establishments of a like character. Isolation necessitates ready recourse to expedients which may meet every possible contingency, and the head of the mining executive deserve high praise for placing such at the orders of his subordinates.

Two of four Lancashire are in position and a store shed of considerable dimensions is in course of erection. Several handsome bungalows and pile of offices are also nearing completion.

The coal continues to improve dipward, and when worked 'face on' gives a good proportion of large to small.

So far as a market for the coal is concerned, there is no present fear of the supply exceeding the demand.

It is seldom that a colliery has such a 'coign' of commercial advantage as the coal mines of the Hyderabad (Deccan) Co. To the South and West there is no rival inside sea limits. To the North-West, Warora and Umaria contend supremacy a little south of Poona, but it is thought by experts that even where they contest the same common market that the pull of 'quality' lies with the younger mines.

#### BURMA.

(From our own Correspondent.)

SINCE the extra steamers have started running from Rangoon direct to Mandalay, the Directors of the Irrawaddy Flotilla Company, Limited, have turned their attention to the speed of their steamers: with this object in view, some of the new steamers are to be fitted with triple expansion engines, compactly constructed, to be of a much lighter weight than the ordinary marine engines now in use. It has been proposed to fit these engines with three cranks, which is deemed an important factor in the increased speed of engines, and is estimated to give an increase of over 10 per cent. in the speed. It is also proposed to increase the piston speed. Another very important feature will be to reduce the weight, in the shape of making the cylinders, and other covers of cast steel, instead of cast-iron hitherto in use; the steam chest, doors and other small details to be proportionately reduced. At the same time a factor of safety is to be strictly allowed, so that all the working parts can be fully depended on, so as to ensure the full power, for any length of time with certainty, and without any increase of wear and tear. These marine engines will be constructed by Messrs. Denny Brothers, Dumbarton Works.

Steel ties after having undergone a careful test for the past four years, on different parts of the line, are now displacing the teak railroad ties hitherto used on the open line of the State Railway. Teak so far has been found the best timber yet used for this purpose, and has been found to last as long as 10 years: but the use of steel ties economises the expense of spikes, and is reported to last from 40 to 50 years. The low price now ruling has been a great inducement not only of substituting steel ties, but also a large quantity of steel rails are now being used in this Province.

A very simple method of obtaining the height of water under ground was tried recently by one of Messrs. Shone and Ault's

Engineers; in connection with the machinery now being laid for flushing drains. The trial was made to test the effect of force on the water underground, and for this purpose a few pipes were driven into the ground, after the elevation of the top of each pipe was determined, the exact distance of the water was obtained by lowering a small weight, to which was attached a piece of metallic potassium, and the moment it came in contact with the water, a report and a flash was the result.

The property of the defunct Steam Laundry Company has at last found a purchaser in a wealthy Mahomedan of this City, who is now endeavouring to float a Company to work the business: shares are being eagerly bought in, and we congratulate the speculator in his new venture, and it is hoped (for his enterprising character, and for saving an expensive undertaking doomed sooner or later to wreck and ruin) that he will benefit by the transaction, in the same manner as the shrewd German, who originally introduced this scheme in such glowing terms, and after having successfully launched the business, quietly withdrew with a clear profit of Rs. 20,000. However, there appears to be every chance of the Laundry proving a financial success, as the concern is to be worked by an experienced and practical Superintendent, with promises of greater public support.

The evils of sending out Engineers, who are unacquainted with the aspects and conditions of a country for Railway construction, is becoming very apparent. In the selection made during the Toungoo-Mandalay construction, many of the officers were pitchforked into positions, before they had time or thought to study the country and its surroundings, and the results of such a choice are manifest in the present unsatisfactory state of the open line of the Toungoo-Mandalay Extension. Setting aside the faultiness of many of the bridges, a number of the diversions, crossings, and sidings are at this time of the year flooded, and traffic in consequence at a standstill. At the time we are writing we just hear that one of the large iron girder bridges at Sawa, near Yamethin, has been damaged through the floods. All these evils are more or less attributed to the fact that no attention has been paid to the drainage of the country through which the line runs; and that the necessary precautions against a flood were lost sight of in the construction. It is feared that in consequence of these evils that the line will not be opened so early as originally intended.

Our readers may recollect that in one of the early numbers of this Journal, we had occasion to comment on a new Graving Dock and Grid Iron, just then started by Mr. J. Macrory of this Port; but we now have to report, with extreme regret, that through his untimely death the whole of the ship-building yard—fast approaching completion—will be sold by auction at an early date. We would add that such a dock is greatly needed at this Port, where there is none other suitable enough for the reception of large vessels. This is a venture well worth the attention of capitalists. The dock is 450' x 52'.

#### CHINA.

(From our own Correspondent.)

SINCE the date of my last letter, a few miles of portable Railway, with trucks, &c., have been purchased and forwarded to the Yellow River embankments, where it is said the strange innovation is affording considerable satisfaction. A powerful electric light plant has also been used, and is giving much satisfaction, as it permits of the work being carried on day and night. A couple of steam launches were also sent up, but they are not being used, owing to the absence of charts of the river, and the ignorance of the Chinese, who are in charge. These navigators are only able to follow in the tracks of foreigners who have navigated before them, and made useful charts of those parts through which they have passed. The stopping of the breach in the embankments is said to be progressing very favorably, so far, but the snows which are now beginning to melt in the mountains of Thibet and Kokour, will soon increase the volume of water so considerably that the work may have to cease for some time. The material used is of such a perishable nature that much of it will no doubt be washed away, when the floods come, and the ultimate results will probably be, that the river will be allowed to flow in its present self-chosen channel, rather than in the artificial one in which it has been forced to flow hitherto. It is a good job the Chinese Government did not avail itself of the proposals of a certain



British Engineer, who offered to treat this mighty river as if it had been a mere canal which might be regulated by *reservoirs*. Progress in China is fortunately not limited to the Yellow River works, but to various other subjects, especially mining and metallurgy in Western China, where such things are now receiving something like sensible attention. Last month, a plant of machinery for the manufacture of iron and steel, on the most approved Western methods, passed through this port on its way to Ch'ing Chi Hsien, a country in the Prefecture of Ssu-Chou, Fu, Prefecture, Kuei-Chou Province, West-Central China. The exact locality of the projected works has not yet been finally decided upon, but it is intended to establish the plant as near as possible to the mountain stream from which the country derives its name, Ch'ing-Chi or Clear (Pure) stream. Minerals of all kinds are known to abound in various parts of Kuei-Chou Province, but the reasons given for selecting this particular locality or country are first because iron ore of excellent quality is found scattered all over the neighbouring hills, like boulders on a beach, as if purposely rained down by an All-Wise Providence, ready to the hand of man, for running into plough-shears and breech-loading cannons. Secondly, because the force of the stream may be utilized in driving some kind of water-wheel, either vertical or horizontal, which may furnish the motive-power required for running the machinery. Thirdly, because the manufactured products of the works may be shipped direct from the works into boats or conveyance to suitable markets for such like produce, without further handling. Fourthly the fuel required for reducing the ore and converting the same into marketable stuff may also be conveyed from the place of production to the place of consumption. Coal from the mines, and charcoal from the pits, within easy reach of the stream, can no doubt be thus economically conveyed to the works. It is, however, contemplated to have a light Lartigue railroad to connect the works with some coal mines 20 miles or so away—that particular kind of coal it is said being much better adapted for the manufacture of iron than coal from mines nearer to hand, which is said to be very sulphurous. The whole surrounding country is, however, so very mountainous, that railroading in those parts must necessarily be very costly, and probably beyond the means of the present company to undertake. Charcoal, however, is abundant, and very cheap, and as the manufacture of steel is said to be the principal object in view, the company stands a good chance of being successful, if the management is allowed to remain in proper hands. An English Engineer, named Elliot, is said to have arrived in connection with this undertaking, but I have not seen him, or heard whether he is to undertake the management of the works after having erected the plant, or to be allowed to return to England. For the present, I believe, that he is gone to Shantung, to see what can be done there in the way of manufacturing iron and steel.

## BOMBAY.

(From our own Correspondent.)

THE scheme for the establishment of a "Zoo" in Bombay, begins to assume practical shape and no longer floats in the dim regions of cloudland. Up to yesterday Rs. 23,700 had been subscribed to promote the enterprise, and it must be admitted that this is a very fair result, when it is considered that the subscription list has only been open about a week.

The local press are lending enthusiastic support to the Natural History Society. In fact, the *Times of India* headed the subscription list with Rs. 500. In its columns two glowing leaders have appeared, eulogizing the project, and pointing out the advantages which the worthy citizens of Bombay would derive from having a "Zoo" in their midst. The animals in the Victoria Garden are to form the nucleus of the collection, and their keep is said to cost about Rs. 8,000 per annum to the Municipality. It is contended that the Municipality should make a free gift to the Society of all these animals, and by so doing be relieved of the stigma under which it at present lies, of treating them with neglect. And it is further contended that by way of amendment for past misconduct, the very least the Municipality can do is to pay for the future cost of maintaining its pets.

It remains to be seen whether the Municipality will take this view of the case. The *Times of India* is responsible

for the statement, that not more than five per cent. of the population of the Bombay Bazaar ever saw an elephant or a camel, and fervidly adds that the spectacle of these two animals alone is certain to prove little short of a liberal education to many a stay-at-home native of Bombay.

It is refreshing to be informed by the same paper that the Gardens will not be desecrated by the presence of a bear-pit within its precincts. Perish the thought!

But, apart from the exaggerations of enthusiasts, there is no doubt that a properly organized "Zoo" would supply a void in Bombay. Not a few however (shall they be called pessimists) are of opinion that the native community cannot be depended on to lend permanent support to the scheme, and that as the European community is relatively small, the Gardens could never be kept going by their patronage alone, even with an annual grant of Rs. 8,000. It is quite certain that if the Gardens are to be on anything like the grand scale described by the *Times of India*, the cost of keeping them will be very considerable indeed.

A great deal has been lately written as to the desirability of a new Factory Act for India, and in connection with this question it has been pointed out by one of the advocates of a new Act, that the production per spindle in England has increased fully 10 per cent. although the hours of work are less than they used to be. Beyond all question, the present hours of labor are iniquitous, and even for the strong adult are injurious to health, to say nothing of the poor little children employed in mills.

The Inspector of Steam Boilers, Bombay, has issued a circular prohibiting the practice of two or more mills being placed in charge of one Engineer. Each mill is now required to be in separate charge of a duly certificated Engineer under the Act. Moreover, when boilers are under steam, the Engineers in charge are not to quit the premises except when relieved by an Engineer of the class deemed capable, according to the rules, of having charge of them. Boilers are on no account to be left in charge of uncertificated men and the Inspector of Steam Boilers has given it plainly to be understood, that any breach of the above regulations will be attended by prosecution under section 27 of the Act.

The expediency of these regulations will only be questioned by interested parties, such as selfish mill-owners, who make every consideration subservient to that of personal gain, and by Engineers who undertake a plurality of duties, which they cannot efficiently discharge. Those persons, however—and fortunately they form the great majority—who attach more importance to the safety of human life than to the acquisitive solicitude of mill-owners and Engineers, will applaud the measures now adopted.

On the 9th instant Mr. Robert Fairbairn, C.E., who came out to India many years ago for the Bombay, Baroda and Central India Railway, died in the European General Hospital. According to all accounts, Mr. Fairbairn was a man of great intellectual powers, and might have risen to the highest position in his profession.

On the 11th instant the Bombay Town Council considered a letter dated 2nd idem from the Acting Municipal Commissioner, asking the Council's approval to his applying to Government, under the terms of section 293 of the Municipal Acts of 1872 and 1878, to declare that a plot of land, situate at the junction of Khetwady and Charni Road, admeasuring 5,490 square yards or thereabouts, was required for the erection of a Hospital for epidemic diseases.

Dr. Geo. Waters proposed that the Town Council should give the approval solicited, and expatiated at considerable length on the necessity of a Cholera Hospital for Khetwady, as being central to a large area where the disease usually prevails. This proposition was seconded by Colonel G. Merewether, who, true to his traditions, was identified with a minority, an amendment being carried that the consideration of the question should be postponed for four months. The Acting Commissioner gave another undignified exhibition of his natural petulance, when the Chairman said that he entertained no doubt, if it became necessary to abandon the site at Khetwady, Mr. Charles would consider what was the next thing to be done. The latter curtly replied that he would do nothing of the kind.

There has been some rain lately but the average is still far behind that of last year.

XENOPHON.



## The Gazettes.

## PUBLIC WORKS DEPARTMENT.

## Burma, July 14, 1888.

Mr. C. H. Wollaston, Assistant Engineer, 3rd grade, Arakan Division, has passed the professional examination prescribed in Public Works Department Code.

With reference to Government of India, Public Works Department, Notification, dated the 14th June 1888, Mr. D. Jocelyne, Executive Engineer, 2nd grade, reported his arrival at Rangoon on the forenoon of this date. Mr. Jocelyne is appointed to be Assistant to the Chief Engineer and Assistant Secretary to the Chief Commissioner in the Public Works Department.

Mr. James Wallace, Assistant Engineer, 1st grade, officiated as Executive Engineer of the Bhamo Division from the 9th to the 18th August 1887, both days inclusive.

## Assam, July 14, 1888.

Mr. W. McM. Sweet, District Engineer, Sibsagar, and Manager of the Jorhat State Railway, who was granted privilege leave for three months in orders dated the 5th June 1888, availed himself of the same from the afternoon of the 7th July 1888, and made over charge of the office of the District Engineer, Sibsagar, on the forenoon of the 6th July 1888, and the management of the Jorhat State Railway on the afternoon of the 7th instant, to Mr. D. J. Clancey, Officiating District Engineer.

Mr. D. J. Clancey, Assistant Engineer, 1st grade, who was transferred to Sibsagar, and appointed to officiate as District Engineer of that district, reported his arrival at Sibsagar on the afternoon of the 29th June 1888, and took over charge of the office of the District Engineer, Sibsagar, on the forenoon of the 6th July 1888, and the management of the Jorhat State Railway from Mr. W. McM. Sweet, District Engineer of Sibsagar, and Manager, Jorhat State Railway, on the afternoon of the 7th July 1888.

## Madras, July 17, 1888.

The following promotions are made :—

Mr. J. J. Whiteley, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 13th June 1888.

Mr. J. H. Medlicott, Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 24th June.

Mr. H. E. G. Evans, Executive Engineer, 4th grade, sub. *pro tem.*, is granted furlough on medical certificate for two days in extension of the leave granted to him in Public Works Department Notification published on the 27th September 1887.

## Punjab, July 19, 1888.

Mr. W. A. Lesmond, Executive Engineer, is transferred temporarily from the Office of the Engineer-in-Chief, Patiala Railway, to the Patiala Railway Division.

## Irrigation Branch.

Mr. J. T. Farrant, Executive Engineer, 4th grade, temporary rank, from the Ferozepore Division, Sirhind Canal, which he left on the forenoon of the 18th June 1888, to the Patiala Division, Sirhind Canal, which he joined on the forenoon of the 20th idem.

## Bombay, July 19, 1888.

Major W. Osborn, R.E., Executive Engineer, 1st grade, is allowed furlough on medical certificate for six months under Section 52 of the Civil Leave Code.

## N.-W. P and Oudh, July 21, 1888.

## Irrigation Branch.

With reference to Notification dated 20th June 1888, transferring him to the 3rd Circle of Superintendence, Mr. J. H. A. Ivens, Executive Engineer, 4th grade, sub. *pro tem.*, is posted to the Eastern Jumna Canal.

With the sanction of the Government of India, the services of Mr. A. J. Hughes, Temporary Superintending Engineer, 3rd grade, are placed at the disposal of the Municipal Department, North-Western Provinces and Oudh.

## Buildings and Roads Branch.

Mr. C. H. Holme, Executive Engineer, 4th grade, temporary rank, is appointed District Engineer, Saharanpur, *vice* Mr. J. Cleburne.

## Central Provinces, July 21, 1888.

With reference to Government of India, Public Works Department, Notification, dated 25th May 1888, Colonel J. P. Steel, R.E., Chief Engineer and Secretary to the Chief Commissioner, Central Provinces, in the Public Works Department, made over charge of his office, on the afternoon of the 30th ultimo, to Mr. C. S. R. Palmer, Assistant Secretary, as a temporary measure.

## India, July 21, 1888.

In continuation of Public Works Department Notification dated the 6th June 1888, Mr. R. D. Perceval, Assistant Engineer, 1st

grade, State Railways, is promoted to Executive Engineer, 4th grade, temporary rank, with effect from the 6th January 1888.

## Military Works Department.

Lieutenant C. E. Norton, R.E., Assistant Engineer, 1st grade, is appointed to officiate as Executive Engineer of the Lucknow Division, Military Works, with effect from 1st July 1888, during the absence of Captain G. Davidson, R.E., on privilege leave, or until further orders.

## Assam, July 21, 1888.

Under the authority conveyed in Government of India's letter dated the 28th June 1888, Public Works Department Notification, dated the 11th May 1882, published in the *Assam Gazette*, dated the 13th idem, authorising the existing distribution of Public Works Department executive charges, is cancelled, and the following re-distribution is hereby sanctioned :—

(1) Khasi and Jaintia Hills, including Cherra-Companyganj State Railway.

(2) Garo Hills.

(3) Naga Hills.

(4) Lakhimpur.

(5) Sibsagar, including Jorhat State Railway.

(6) Central Assam, comprising Darrang and Nowgong.

(7) Lower Assam, comprising Kamrup and Goalpara.

(8) Sylhet.

(9) Cachar.

2. The following postings of officers to the new divisions are hereby ordered in supersession of all previous postings :—

(1) Khasi and Jaintia Hills.—Head-quarters, Shillong—

Mr. T. H. Jewett, Executive Engineer, 3rd grade, sub. *pro tem.* to the charge of the division.

Mr. E. J. Mitchell, Assistant Engineer, 1st grade, attached.

(2) Garo Hills.—Head-quarters, Tura—

The Deputy Commissioner to have charge of all Public Works *pro tem.*

(3) Naga Hills.—Head-quarters, Kohima—

Mr. J. T. Rollo, Executive Engineer, 2nd grade, to the charge of the division.

Mr. W. E. Knight, Apprentice Engineer, attached.

(4) Lakhimpur.—Head-quarters, Dibrugarh—

Rai Durga Das Das, Bahadur, Sub-Engineer, 1st grade, and honorary Assistant Engineer, to the charge of the division.

(5) Sibsagar.—Head-quarters, Sibsagar—

Mr. W. McM. Sweet, Executive Engineer, 4th grade, temporary, rank to the charge of the division.

(6) Central Assam.—Head-quarters, Tezpur—

Rai Bholanath Dass, Bahadur, Executive Engineer, 1st grade, to the charge of the division.

Mr. Bolinaryan Borrah, Executive Engineer, 4th grade, temporary rank, attached for employment at Nowgong, under the Divisional Executive Engineer.

(7) Lower Assam.—Head-quarters, Gauhati—

Mr. O. G. Smart, A.M.I.C.E., Executive Engineer, 3rd grade, sub. *pro tem.*, to the charge of the division.

Brij Mohanlal, B.A., Rai Sahib, Assistant Engineer, 1st grade, attached for employment at Dhubri, under the Divisional Executive Engineer.

(8) Sylhet.—Head-quarters, Sylhet—

Mr. D. J. Clancey, Assistant Engineer, 1st grade, to the charge of the division.

Matadin Sukul, M.A., Rao Sahib, Assistant Engineer, 3rd grade, attached.

(9) Cachar.—Head-quarters, Silchar—

Rai Preonath Banerji, Bahadur, Executive Engineer, 3rd grade, to the charge of the division.

Consequent on the absence on sick leave of Rai Bholanath Dass, Bahadur, Executive Engineer, and on privilege leave of Mr. W. McM. Sweet, Executive Engineer, who has been appointed in above Notification to the Executive charges of the Central Assam and Sibsagar divisions respectively, the following temporary arrangements are made :—

Mr. Bolinaryan Borrah, Executive Engineer, 4th grade, temporary rank, to have temporary executive charge of the Central Assam Division.

Mr. D. J. Clancey, Assistant Engineer, 1st grade, at present in temporary charge of Sibsagar and the Jorhat State Railway, to continue in temporary executive charge of the Sibsagar Division.

Mr. R.E. Nelson, Executive Engineer, 2nd grade, and District Engineer, Goalpara District, who was granted furlough for nine months in orders dated 30th April 1888, made over charge of the Goalpara District to Rai Sahib Brij Mohanlal, Assistant Engineer, on the afternoon of the 13th July 1888.

With reference to the above, Rai Sahib Brij Mohanlal, B.A., Assistant Engineer, received over charge of the Goalpara District from Mr. R. E. Nelson, Executive Engineer, on the afternoon of the 13th July 1888.

## Bengal, July 25, 1888.

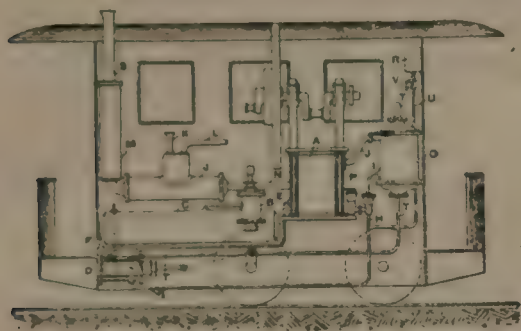
With reference to Notification of the 17th June 1888, Mr. J. T. Boase, Executive Engineer, is posted to the office of the Superintending Engineer, Orissa Circle, which he joined on the 2nd instant.



# Indian Engineering Patent Register.

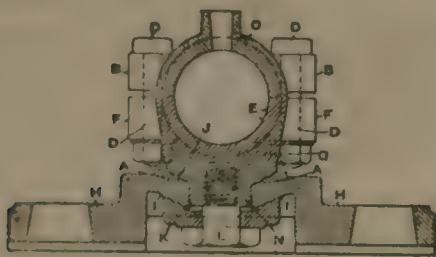
## RECENT BRITISH PATENTS.

**COMBINED GAS AND COMPRESSED AIR ENGINES.**—*E. Stevens, Brussels.* These improvements are applicable to locomotives which are used on railways. The gas engine is combined with the compressed air engine in such a way that the cylinders of each engine are covered with water jackets communicating with one another; the water is caused to circulate between them by means of a pump, for the purpose of cooling the gas cylinder and heating the air cylinder. The general arrangement is shown in the accompanying figure. The gas motor A serves two purposes, viz., to actuate the air compressing pump B, and to drive the pump P, which is employed to set the water in circulation. The pump B compresses the air into the receptacle C, whence the air passes through the air motor D and into the receptacle O. The gaseous fuel is composed of compressed air and the vapour of naphtha, petroleum, or other hydrocarbons. The exhaust gases from the gas motor A pass through a series of tubes inside the vessel J, in which is contained the hydrocarbon; the air enters at K, and the gaseous mixture leaves at L for the induction valve of the motor A. The products of combustion, after having evaporated the fuel, pass through the vessel M and pipe S into the atmosphere, and an asbestos lining is fixed inside the vessel M, for the purpose of deadening the puff of the engine. The air motor D is provided with a jacket in the same manner as the



gas motor A, and the tube E F connects the interior of the two jackets. The jacket of the motor D is connected by means of the tubes G H with the pump P, whose pressure tube I is led to the cooling apparatus O. The water of the two jackets is sucked into the apparatus O by the cooling action of the exhaust air from D. The air leaving the cylinder of the air motor enters through the tube T-1 into the interior of O, and escapes through the tube T-2, and the water sucked by the pump P through the pipe G H from the cylinder jackets enters through the pipe I into the space in O surrounding the pipes through which the cold air passes and flows off through the pipe J to the jacket of the gas motor. To compensate for the gradual loss of cooling water, and to supplement the cooling effect of the vessels O, a small cold water reservoir R is arranged, from which the water can be let direct into the pipe G H through the pipe U. Three claims are made for the combination of the double walled cylinders D A with the chamber O and the pump P for the purpose of keeping up a constant circulation of the cooling water, for the carburetter, and for the silent exhaust apparatus M, as described.—No. 4843. 31st March 1887.

**PEDESTALS FOR ROTATING SHAFTS.**—*W. Hargreaves & R. Harwood, Bolton.*—The object of this invention is to allow for the self-adjustment of pedestals in order to reduce the strain and friction due to errors of level or alignment. The body E of the pedestal is provided with a vertical stem G; the under side of the stem takes the form of a



spherical surface, whose centre coincides with that of the bearing. The upper side of the base plate H is constructed with a concave surface A, which receives the convex end of the stem G. The under side of the base plate H is formed with a spherical surface I struck with a radius from the centre of the pedestal. This surface bears upon the disc K, which is secured to the pedestal and to the base plate. The base plate has a slot which admits the projection N; the slot allows the adjustable part of the pedestal to swivel longitudinally, but prevents it tilting laterally. The snugs F are cast on the body E of the pedestal, and

receive the bolts D by which the cap C is secured. The base plate H can be provided with an oil dish if desired. This arrangement of the bearing and its supports allows of the self-adjustment of the bearing. Two claims are made for this bearing and for another modification.—No. 6329. 30th April 1887.

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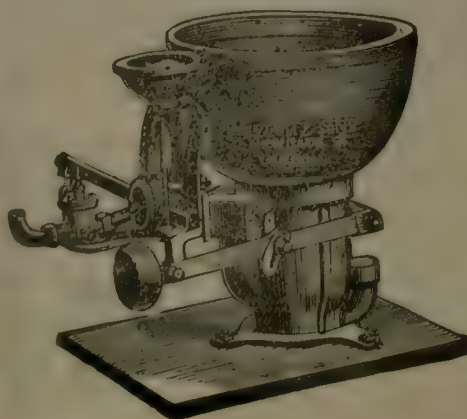
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Mechanical Engineer,  
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INDIAN ENGINEERING.

SATURDAY, AUGUST 4, 1888.

THE WESTERN BENGAL RAILWAY SCHEME.

CIRCUMAMBIENT air is full of promising Railway projects: the times are ripe for them, weary of waiting for them and by no means inclined to brook denial of their fulfilment, their actual tangible embodiment in iron horses and steel rails, and greased wheels, be the much-discussed rupee valued at one and four pence, or at some decimal of four farthings. As to that financial consideration, experts in the much-vexed currency question tell us that the only means left us of galvanizing the dead and gone two-shilling rupee into redemption from death beyond the grave of all hope is promotion, creation, of an export trade; and it is as patent that the only efficient way to set an Indian export trade on its legs is to make railways all over India—so that inter-communication may be secured in the Mofussil, and country produce may be conveyed cheaply and expeditiously from the place of its growth to the nearest port.

That is one thing which Sir Bradford Leslie's proposed Western Bengal Railway (the motif of this article) proposes to do, inasmuch as it would afford the most direct route between the great rice-producing districts of Beerbhoom, Burdwan, and Benares, and provide them with a suitable sea outlet for as much grain stuff as local agriculturists choose to raise from the land they live in; some of which has been allowed to lapse into jungle, simply because if crops were grown on it, they could not be got to the coast, or to any eligible market, unless loaded on gharries or pack bullocks—methods of progression that would take all the gilt off the gingerbread of a trade venture. We ought rather to say—a trade folly—foredoomed because of extraneous economic conditions, and lack of supplemental controlling agencies to result in loss instead of in profit. Again, consumption of rice as a staple food, instead of atta, is steadily increasing, and must needs prove a valuable item of Railway traffic. Let the Western Bengal Railway secure it in timely season, Sir Bradford Leslie suggests, noting by the way that his proposed line would furthermore fulfil a great want in providing the important towns of Kutwa, Nuddea, and Khoolna with Railway communication to Calcutta, and the upper provinces as well. His argument runs:—

In normal seasons the average through goods traffic between Benares and Howrah is not less than 100,000 tons per annum; and this traffic, which would properly belong to the extension of the Oudh and Rohilkhand Railway, is certain to increase, consequent on the opening of the Dufferin Bridge.

At the average rate of earnings on the East Indian Railway, 100,000 tons carried 450 miles would produce 14 lakhs of rupees.

The local goods traffic from the rich producing districts of Behar and Shahabad, fertilized by the Sone irrigation



canals, would be very valuable. There would also be a large traffic in lime from Rhotasgurb, which would probably supersede the Kutni and Sylhet lime in the Calcutta market. The rice traffic between Ahmoodpore and stations below and Benares, already referred to, would be another source of revenue, and the portion of the line running through the Burdwan and Nuddea districts would contribute a fair amount of goods traffic both up and down. On the whole, the local goods traffic may be assumed at not less than Rs. 50 per mile per week.

Then, as to passenger traffic, we are told that, since the proposed line will afford an absolutely direct route both from Upper India and Lower Bengal to the much frequented shrines of Baidyanath, Gya, and Benares, and since it also invents a natural outlet for the coolie emigration of Chota-Nagpore, passenger traffic cannot fail to be abundant. It will be added to, there is every reason to believe, between Kutwa and stations below that, and the terminus at Calcutta. The average receipts of the East Indian Railway from passenger traffic are not less than Rs. 160 per mile per week, says Sir Bradford Leslie. On the Bengal Division they are very much greater. It may safely be assumed, then, that the passenger traffic on the proposed line will be at least Rs. 100 per mile per week; making Rs. 150 per mile per week the *total* local traffic. This is considerably less than the traffic earnings of the Patna, Gya, and Tarkessur branches of the East Indian Railway—a designedly very low estimate in fact. Rs. 150 per mile per week would yield a return of 33 lakhs of rupees per annum on the 425 miles between Mogul Serai and Hooghly. "With working expenses at 40 per cent.—and considering the advantage of being part of a large concern, and of cheap fuel from the Bengal coal-fields, they should not exceed this ratio—a traffic of 47 lakhs would yield a net profit of 28 lakhs." Say,  $7\frac{1}{2}$  per cent. on capital outlay.

The proposed line is by no means intended to be set up as a rival to the East Indian, contrariwise. It would be to some extent a feeder thereto, and Sir Bradford Leslie inclines to think that the new traffic to be developed by it would more than compensate for any loss of through goods between Mogul Serai and Howrah. The East Indian Railway, it should be remembered, follows the course of the Ganges, which forms the northern boundary of what is called Western Bengal—a territory of 60,000 square miles, with 22 millions of inhabitants, and it cannot reasonably be contended that this large country, equal in area and population to England and Wales combined, is adequately served by 700 miles of East Indian Railway, running hundreds of miles away from some of its most fertile tracts. It is suggested that, in the event of the East Indian Railway being breached by floods above Luckee Serai—a contingency of not unfrequent occurrence—the relief afforded it by an alternative route for its traffic, if only for a few weeks even, would compensate for "any loss of traffic it might sustain for many years."

For the rest, Sir Bradford Leslie's name carries with it almost an assurance of success; is about the best

guarantee of success the proposed Western Bengal line could have. *Floreat!*

### A GREAT PROBLEM.

THE long expected despatch by the Imperial Government on the subject of sanitation in India, which was sent home for the approval of the Secretary of State, has received his sanction, and is published in the last number of the *Gazette of India*. That the spirit in which the despatch is conceived is commendable, and that the development of the policy marks an important epoch in the administration of the country will hardly admit of any doubt; but at the same time it must be said that the execution of the grand project is attended with serious, if not insurmountable, obstacles. To confess the truth, the document itself gives evidence of this. Of the impediments in carrying out the necessary reforms, first and foremost stands the ignorance of the 'masses' and their conservative habits. This is an important factor in a consideration of the question and too much stress cannot be laid on it. We know from past experience, how a native of the soil is wedded to customs invested with a halo of venerable antiquity, and his inherent dislike to a change in any direction—in other words, custom is religion in the East. But we have also lived to see him accept the inevitable with some sort of grace, and adopt modes and practices not in harmony with preconceived ideas. As the advancing wave of education penetrates into the nooks and corners of the lower grades of native society, the bulwarks of prejudice are gradually but steadily giving way to it. But without stopping here to predict the probable period when such a consummation will take place, let us face the difficulty under existing conditions.

With the measures calculated to promote the cause of sanitation are intimately associated the question of executive agencies and funds. The former is again divided in its relation to urban and rural areas. With regard to the first, the powers conferred on Municipal Boards have been greatly amplified, and the Municipal Acts have entrusted to them larger discretion and authority to enact rules and bye-laws for sanitary purposes; in fact, a duty has devolved upon them of providing for the sanitation of towns, as far as the funds at their disposal will permit. A good deal of independent action rests in them. In the case of rural areas, though they do not enjoy equal powers, they might yet impose taxation to a limited extent, and may raise loans under Act II. of 1879 for similar purposes.

With a view of assisting Municipalities and other Local Boards, the Government of India proposes that there should be established in each province a Sanitary Board through which the Local Government should operate, and which under its orders be entrusted with the control and supervision of all sanitary works, whether undertaken in urban or rural areas. These Boards to consist of an officer who has had administrative experience, a Sanitary Commissioner for the Province, and an



officer of the Public Works Department, who is also an expert in Sanitary Engineering, assisted by three non-official members appointed by the local Government.

Now, in order to carry out any effective sanitary reforms, it is necessary that the requirements of each locality should be as far as possible accurately ascertained. The Imperial Government, therefore, refers to the orders issued by the Home Department on Municipal and Local Board reports for 1885-86, in which general lines are laid down on which the future action of local bodies should be directed in promoting sanitary reforms. To accomplish this a suggestion was made to various local Governments to make a sanitary survey of each Municipality and rural area, and that plans and estimates should be prepared of all improvements necessary to provide each town or village with an efficient system of water-supply, drainage and conservancy. In the opinion of the Government of India the most important are the two former, and they may be most effectively dealt with the best chance of active support and sympathy of the people; especially in localities in which public works, such as Railways and canal embankments have interfered with the outlet of water, and which must, as a matter of course, interfere with the health of the people.

The next point to be considered is the raising of the ways and means, or the borrowing powers of the several Municipalities to obtain funds for local expenditure. Here is an anomaly. By the Madras, Bengal, and Punjab Local Boards' Acts power is given to them to raise funds, a provision neglected in the case of Bombay, the North-Western Provinces and Oudh. This the Imperial Government recommends should be remedied by the Legislative Councils of these administrations. But what we fail to understand is, how, "though sufficient money to meet the current expenditure may be provided in these ways, it will probably be necessary to raise additional funds for the execution of new or large works. It is, indeed, probable, that the local income may be increased without any hardship to the tax-payers." Can this be done without levying fresh taxes? We fear not, and any imposition of new taxes will produce discontent.

In a cursory review of the subject we have been obliged to overlook points which would otherwise be worthy of earnest examination, but considering that we have already exceeded the space at our disposal, we will merely refer to that portion of the despatch which deals with the subvention of sanitary reforms from provincial resources in those parts of urban and rural areas, where local bodies are not able to raise loans owing to their credit not being established. The Indian Government approves of such help being offered and would like to see provisions made for them in the Provincial Budgets, when it could be done along with other demands on local Governments. The Imperial Government is even prepared to go beyond this, and where there are "exceptional cases, the requirements of which cannot be met from local or provincial resources or by loans," it will, in rare

cases, "not refuse to consider the applications from local Governments in the interests of sanitary improvements of more than local importance."

### A SUGGESTION.

#### III.

THERE is one other point which we desire deferentially to submit to the consideration of the Government. A well known and crying want of the country is "Technical Education." Under this head may be classed a very wide collection of items, from ordinary carpentry to the highest skill of Engineering; of architectural knowledge, from ordinary tasteful domestic architecture to the designing of public buildings; from house painting to high artistic drawing; from the brewing and distilling of country liquor to the refined products of modern chemical laboratories; and from the weaving of mats to the manufacture of velvet and lace. We are at present concerned with the first two only of these arts. The Engineering Colleges of Roorkee, Seebpore, Madras, and Poona, already give as good a training in Civil Engineering as can be expected, or is likely to serve any useful purpose; while both Roorkee and Seebpore give, in addition, to those who wish, a very fair knowledge of carpenters' and smiths' work. We think the knowledge and practice imparted in these branches may, however, be improved; at any rate, they may be supplemented by a practical course in brick-making, lime-burning, cement manufacture, ordinary brickwork, stone-quarrying and cutting, as used for building purposes, and stone masonry; and instructors from the Public Works Department, well versed in these matters, may be appointed to impart the necessary instruction; thus relieving the congestion, not indeed in the higher grades, but, in the upper subordinate grades of P. W. officers, some of whom have long and varied experience and draw salaries which are higher than those of Assistant Engineers.

As regards architecture, we consider that the wants of the country absolutely need the institution of professorial chairs for this branch—the highest development in one direction it may rather be called of the Engineer's profession. Who that has read the caustic remarks of foreign visitors to India on our ordinary P. W. Buildings; nay, who that has read the disparaging, and, we must add in many cases deserved, remarks in disparagement of the ordinary productions of the Indian Public Works in the "Journal of Indian Art," a publication, by the way, published under the auspices and with the authority of the very Government of India whose Engineers are there held up to ridicule as Architects, but must have felt the force of the remarks, and wished that some means could be devised by which an architecturally better class of buildings might be turned out? We go further; we say that what is wanted is special knowledge in architecture of the West and special knowledge in Indian and Oriental architecture. The field of architectural knowledge is too wide by far, and the forms and canons



of Western and of Eastern architecture a vast deal too different for one professorial chair to be able to impart instruction, which will be useful, instead of worse than useless, in both the vastly diverse styles. We have no desire to run down any one, least of all deserving and conscientiously laborious Engineers of the Public Works Department, but no one can look at the pretentious, and most expensive, Muir College in Allahabad, without being struck with the conviction that some more technical knowledge of Oriental architectural forms and devices would have given us a building which need have feared hostile criticism from no artist, foreign or English.

The fact is, the few Engineers which the Government of India possesses, who are also Architects, are trained up, and necessarily trained up, and familiar with, Western architecture, and with Western architecture alone. Eastern, and more especially Indian architecture, is an art in which at present we possess but few experts. The late great Dr. James Fergusson was a critic, and unfortunately a critic only and nothing more, of Indian architecture; he was not an Engineer in any sense of the term, and as Mr. F. S. Growse, C.S. has pithily remarked, in allusion to the circumstance of his having never *built* anything, "it would have been interesting to the rest of the world to see what Mr. Fergusson's superior unaided genius could evolve."

But to be an Architect a man must of necessity be first an Engineer; not a great Engineer by any means, but at least one familiar with actual building operations and with the principles of construction and stability, without which architecture is impossible.

This necessity imposes a difficulty in getting a competent man to occupy the proposed professorial chair of *Indian Architecture*. It would be manifestly absurd to install, as professor of architecture, a man who never built anything, and is presumably innocent of all knowledge of the ordinary builder's art.

The professorial chair for Western architecture could be filled easily, as there are several officers in the Public Works Department now whose productions prove their familiarity with the canons of Western architecture; and so far as Seebpore in Bengal is concerned, the selection could, if Government chose, be with confidence left to the new Chief Engineer, Mr. E. J. Martin, who, as an Architect, has proved his knowledge and ability in many a public building: nor as regards Roorkee need any difficulty arise: the real difficulty would be in selecting a man for the chair of Indian architecture: it would be invidious to mention names, but there are but two men in India who could, we believe, with any hope of success, fill the post.

In addition to these appointments, in the interest of technical education in India, we would, for the training up of efficient Engineering and architectural draftsmen, recommend the enlargement, by the appointment of trained Public Works draftsmen as teachers, under the various Superintendents of the Schools of Art in India, (we believe there are three,) of the scope of instruction afforded in these schools.

If our suggestions be favourably looked upon, there would be provided for at once—

(1) Openings for the employment of four upper subordinates, as instructors of brick and lime making, masonry brickwork, &c.; all these four men payable from educational funds.

(2) Two Engineer Officers fairly conversant with Western architecture, as professors of Western architecture; payable from educational funds.

(3) Two Engineer Officers conversant with Indian architecture, as professors of Indian architecture; payable from educational funds.

(4) Three of the best draftsmen, as teachers of Engineering drawing, under the Superintendents of the Schools of Art.

To sum up: Our suggestions provide—

(1) The Directorship of the Archaeological Survey of India; payable from its funds.

(2) Ten appointments for Engineer Officers, in the Archaeological Department; to be paid from Archaeological Survey funds.

(3) Two appointments, as professors of Indian architecture, for Engineer Officers; payable from educational funds.

(4) Two appointments, as professors of Western architecture, for Engineer Officers; payable from educational funds.

(5) Four appointments for the highly paid experienced upper subordinate Officers of the P. W. D., as instructors of practical work, in the manufacture of materials for the Engineer, and their use in building; payable from educational funds.

(6) Three appointments from highest class of draftsmen, as teachers, under the Superintendents of Schools of Art of Engineering drawing and plotting; payable by the Schools of Art, the scope of whose usefulness we strongly recommend should be increased.

Lastly, we beg to point out that the two professorships of Indian architecture and the Directorship would be the prize appointments to incite the zeal of the ten Engineer Officers of the Archaeological Survey. These ten appointments would be divided into five for Assistant Engineers, and five for Executive Engineers of the lower grades; while of the two higher appointments, to which these men might aspire, the two professorships of Indian architecture might be made first grade Executive Engineerships, or lowest grade Superintending Engineerships; and the Directorships to which, in their turn, the two professors might aspire, might be made a second grade Superintending Engineership as regards pay and emoluments.

The two professorships of Western architecture would naturally be filled in by deserving members of the Public Works Engineer staff, who would, in due course, get re-absorbed in the Public Works proper as the time for their promotion came round; their places being filled by others.

We earnestly commend our suggestion to the consideration of the Engineers of the Public Works Department, of Engineers in general and of the Government of India.



## Notes and Comments.

**WATER-WORKS FOR KHATMANDU.**—Mr. Finnimore Bengal P. W. D., visits Khatmandu to carry out a scheme of water-works there.

**THE TRANS-CASPIAN RAILWAY.**—According to the latest official statement, the Trans-Caspian Railway cost the Russian Government less than four million roubles.

**AT LAST!**—It is believed that Mr. R. Woolley will leave London about the 14th September next, when he will have concluded all arrangements for forming the Nilgiri Railway Company and for starting the construction of the line.

**RAILWAY COMMUNICATION WITH SIMLA.**—The Kalka-Simla Railway proposals have fallen through, the proposed concessions being unsatisfactory. The construction of the Umballa-Kalka Railway by the State is under consideration.

**DUTY ON EXPLOSIVES.**—It is notified in the *Gazette* that no fees will be charged for licenses granted for gunpowder and fuses in reasonable quantities when the same are required for blasting purposes in connection with agricultural works and works of public utility.

**TIMBER CONTRACTS IN BURMA.**—Mr. Ribbentrop, head of the Indian Forest Department, left Simla to-day for Burma, to confer with the Chief Commissioner regarding a timber contract granted to the Bombay-Burma Trading Corporation, respecting which questions have recently been asked in the House of Commons.

**MADRAS MUNICIPALITY.**—We learn that Mr. Cecil Scott, Local Fund Engineer of Masulipatam, will act as Vice-President of the Madras Municipality, P. W. D., during the absence of Mr. J. A. Jones on furlough. Mr. Scott acted in the same capacity on a previous occasion and shewed himself in every way to be a good *locum tenens*.

**TRUTH STRANGER THAN FICTION.**—Labor must be cheap and plentiful in Arakan when we see the Sandoway Municipality advertising for a Secretary on a salary of Rs. 50 per mensem. He is expected to do all the clerical work connected with the Municipality, and generally to supervise the Public Works and Conservancy, &c., in the town.

**SUPERINTENDENT, MADRAS HARBOUR WORKS.**—At a meeting of the Harbour Trust Board it was resolved by a majority, that Mr. Thorowgood be allowed to draw pay up to the date of his arrival in England, according to the terms of his original engagement with the Secretary of State, and that should Government approve, the Board are willing to pay his passage home.

**A DOUBTFUL EXPERIMENT.**—Mr. Pyne, the Mechanical Engineer, in the service of the Amir of Kabul, is now in England, collecting a number of English artisans, chiefly gunmakers, for service in Abdur Rahman's workshops. That the high wages offered will tempt this class of men to run a certain amount of risk is quite certain, but the issue of the experiment is necessarily somewhat doubtful.

**COLONEL LUARD, R.E.**—Nothing has recently been heard of this officer's intentions. It is known that he was asked to accept the Chief Engineership of Bengal, but it is very probable that with his sympathy and experience built upon many years of Railway work he will not try his 'prentice hand' in provincial work, which requires a man of architectural qualifications like the present popular Chief.

**TRAMWAY SCHEMES.**—The Tramway scheme in Colombo has advanced a step further. At a recent meeting of the Colombo Municipal Council, a letter from the Colonial Secretary was submitted intimating approval of the concessions proposed to be granted in regard to the proposed tramway. We should very much like to know what further has been done in regard to the proposed tramway for Madras.

**THE SEWERAGE OF MYSORE FORT.**—In this connection a Bangalore paper observes that the City of Mysore claims to be in possession of a complete system of sewerage—at present the only one, we are informed, in India—constructed with pipe drains throughout. The Fort of Mysore, containing about 6,000 people, has been sewered and drained at a cost of Rs. 2½ per head of population, and the works have been in successful operation for over a year.

**INDIAN GOLD MINING ENTERPRISE.**—A South Indian papers says that of the numerous companies floated in the year 1881, to search for gold in South and South-east Wynaad, only five have struggled on to the present time. Mere ghosts of what they were, even these are making little or no pretence to develop the mineral wealth of which they once were accustomed to boast. Failure as regards mining, has been the rule amongst them, and in this respect one concern deserves no more blame than another.

**THE PUNJAB STEAM THRASHING COMPANY.**—An enterprise, with its head-quarters at Kurrachee and Umritsar, has lately been started for the working of wheat-thrashing and cleaning machines in the Punjab. The Punjab Steam Thrashing Company will bring the appliances for cleaning wheat within the reach of cultivators and dealers. The machine which the Company will use has been proved to be capable of doing in one day what by the ordinary native process it has hitherto taken nine days to accomplish.

**UNDER-SECRETARYSHIP, BENGAL IRRIGATION BRANCH.**—Since Major MacArthur, R.E., took up the duties of Superintending Engineer, South-Western Circle, it appears that Mr. G. Shawe has been carrying on the work of Under-Secretary in this branch in addition to the responsibilities attaching to his substantive post as Executive Engineer, Circular and Eastern Canals. Can this mean that there is not sufficient current work to keep an Under-Secretary employed, or that the establishment in the Province is below its proper strength? Or can it be that the Joint-Secretary is a tower of strength in himself?

**CIVIL ENGINEERS' PENSIONS.**—It is notified that all service, whether temporary or substantive, will be counted as service towards the special pension of Rs. 2,000 and Rs. 1,000 authorized for Civil Engineers in 1884, but the periods passed on leave, other than privilege leave, will be excluded. Periods of three months and under during which an officer merely officiates as a purely temporary measure will not count. It is important, however, to bear in mind that these extra pensions cannot be claimed as a matter of right, but that they will only be granted at the discretion of the Government of India, as rewards of approved service.

**RECENT CHANGES AND THE BENGAL P. W. D.**—We congratulate Mr. Nightingale on his selection to assume charge of the Eastern Circle. We recently acknow-



ledged his special claims, and hope to see him continue in the post. Mr. King at present holds charge of both the Patna and Bhagulpore Inspectorships of Local Works, probably pending the decision of the Government of India on the several recent acting appointments. But now-a-days 'plums' are few and far between, and there should be a little less niggardly distribution of prizes—even if the enjoyment of them cannot but be brief.

**FLOORING TILES.**—It is true that locally made tiles in Bengal similar to those associated with the names of Minton, Maw, etc., are offered in the market, but the satisfaction which the English tiles give, does not appear to have been realized from the tiles made in India. This is a great pity, because one would expect that flooring tiles would supersede matting to a very large extent. They form a cleaner, cooler, and certainly more ornamental floor; and in Europe are now largely used for wall decoration, as well as for flooring. Messrs. Burn and Co. appear to have turned their attention of late to this class of goods, and we hope to see them turn out strong well-shaped tiles, of clear and lasting color, and in well arranged patterns.

**MR. STANDISH LEE.**—A contemporary observes that it would be curious to know how many officials of the P. W. D., among them the very superior R. E., sent in Essays on the Bangalore Drainage Scheme. And it is still more curious to find that not a single Government-paid man has been able to cope with Mr. Lee. Mr. Standish Lee passed out from the Madras Engineering College, as an Overseer, and after some years became Executive Engineer of the Madras Municipality, which he left to settle down in Bangalore. He is a man of a very speculative turn of mind, and started a woollen industry at Bangalore. Notwithstanding all this, Mr. Lee seems not to have forgotten his Engineering experience, and here we behold him at the top of the list of essayists.

**WATER-SUPPLY IN THE N.-W. P. AND OUDH.**—The Lieutenant-Governor has lost no time in giving practical effect to his Resolution on the subject of the water-supply of the four largest towns in these Provinces, which appears in the last issue of the *Provincial Gazette*. Mr. A. J. Hughes, Superintending Engineer, has already arrived in Allahabad with a view to consulting with, and advising, the Municipality, and also, framing the preliminaries of projects for water-supply and drainage for that city and station. The Municipality has got the twelve lakhs of rupees it asked for, but the Government has been careful to intimate that all expenditure in excess will be borne without relief from the provincial funds. The water for the Allahabad supply will, we have the best authority for stating, be taken from the Jumna.

**THE SIAMESE RAILWAY.**—By last advices from Siam, four more Engineers have started for that country in connection with Sir Andrew Clarke's Railway projects in that quarter. No doubt, the Railway, when made, will give a much desired impetus to the trade of Siam, and will materially advantage commercial interests by extension in the direction of China. But it should be borne in mind that the King of Siam has as yet given no concession for carrying out the scheme. Sir Andrew Clarke himself was careful to explain that the Siamese Government had merely taken the matter into consideration. All he had secured was permission to carry on preliminary surveys and inquiries. It is to be hoped, in the interests of Siam,

that the surveys in hand will so prove the business practicability of Sir Andrew Clarke's scheme as to admit of a Siamese State guarantee.

**HINDU HOSTEL, CALCUTTA.**—We learn that this Hostel has not escaped the fate which befalls nearly all buildings in Calcutta—the inevitable crack has appeared, in spite of well constructed foundations and substantially built plinth and walls. Anyone, however, who has laid foundations in Calcutta, knows how unreliable the soil is—how invariably it happens that strips of loose earth and rubbish cut through what would otherwise be firm and even soil, and although every precaution be taken of building upon a thick concrete bed, of regulating the spread of footings according to the weight to be carried, and by special measures at the troublesome spots, the break of uniformity is quite sufficient to cause cracks without necessarily endangering a structure. We have ascertained that the foundations of the Hostel were designed so as to press nowhere with a greater load than a ton per square foot, that as good materials were used, and that they were as well put together, as in any structure now standing in the City.

**RAWALPINDI CANTONMENT WATER-SUPPLY.**—Dr. Tanner's question in the House as to whether the native inhabitants of the city of Rawalpindi were now supplied with fresh water at all seasons of the year, which was brought from the River Rawal by pipes laid underground, a distance of seven miles, into the city, while the cantonments, distant about a mile from the city, were obliged to draw water from wells, the majority of which ran dry in the hot season, is evidently stirring some people up. The authorities are now busily engaged in considering the proposed extension of the city water-works to the cantonments. The matter has been occupying public attention since the opening of the city water-works in March 1887. The terms offered by the Municipal Committee for water-supply to cantonments appear to be very generous, seeing that for one lakh of rupees the Military Department are to share works that have cost three times that sum to date, and they are offered free control of the whole work in future.

**MOORE'S PATENT SLEEPER.**—Mr. G. E. Moore, Deputy Consulting Engineer for Railways, Calcutta, has recently patented a sleeper which promises to take a prominent place among the many varieties of this very important item of Railway construction and maintenance. The sleeper consists of two chairs, each of which is formed of a bed-plate, with two brackets so cast upon it as to support the rail on both sides: but by not placing the brackets directly opposite each other, Mr. Moore succeeds in doing away with a large number of loose parts. The rail is laid on the chair in a skew position—or the chair is set under the rail in that manner, and when made square the brackets on the chair clip the rail and the square position is kept by using ordinary fish-bolts to attach the rail to the brackets. The simplicity of this form of sleeper is beyond question, and it is only a matter of trial as to whether it is not destined to supersede most other varieties. It will, of course, from its simplicity and the genuineness of its parts, be cheaper both in material and in the labor of fixing.

**THE FIFTY-YEAR RULE.**—We know that there is a very general feeling among, not only those who would be affected by this rule, but also among those who look upon the rights and wrongs of the case, that this rule is



iniquitous. It is not denied that it is a legitimate course open to the Government to meet the exigencies of the time being to get rid at that age of men who have become unfitted for work; but it surely is a clear instance where compensation may be fairly expected. Some distinction may rightly be made between those who have erred in their career and thus made themselves unserviceable to Government, and those who through ill-health or for other uncontrollable reason have become unfitted for work. Otherwise Government stultifies itself. It admits having from time to time made very gross mistakes in securing the services of incompetent men. The men affected must presumably nearly all have been reported and considered competent when engaged, and only the force of circumstances and the effects of the climate have sapped their energies and intellects.

**SANITATION IN INDIA.**—The resolution of the Home Department on sanitation in India—dealt with elsewhere—points out that the chief reasons why more active efforts have not been made yet to promote sanitation are the want of funds and the absence of a suitable agency. The latter is now partially supplied by the creation of local and Municipal boards, and the principal points to which the attention of these bodies should be directed in the matter of sanitation are pure water, drainage, and conservancy. To assist them there will be appointed in each province a Sanitary Board consisting of a Sanitary Commissioner, a Public Works officer, an administrative officer, and a certain number of non-officials. This Board will undertake the sanitary survey of towns and rural areas, and will advise and direct sanitary operations. As regards pecuniary aid the local Governments will be authorised to raise a loan fund, from which the local bodies will be allowed to borrow for sanitary purposes where improvements of great magnitude are to be undertaken. Local bodies may come direct to the Government of India, and poor local areas will in certain exceptional cases receive free grants of money from local Governments.

**PUBLIC OFFICES IN BENGAL.**—The steady progress made during the last seven or eight years in the provision of public offices and courts in Bengal is still maintained, and every year sees some of the smaller comparatively unknown towns provided with Munsifs' Courts, &c. The principal structures which are now receiving attention are—Combined Public Offices in large stations; Collectorates; Judges' Cutcheries; Subdivisional Courts and Offices; Subdivisional Officers' Residences; Munsifs' Courts; Combined Post & Telegraph Offices; Residences for Officials; Schools and Lock-ups. Nearly all the second-rate towns are now provided, though in several cases the accommodation is far from appropriate. Khoolna is one of the newly created Collectorates and judicial centres, and has rapidly assumed an importance quite unexampled. The steady attention given to it has allowed of its being laid out and constructed as far as it goes as a model town. Chittagong is about to have what will prove a very important feature of the town, *viz.*, a block of Public Offices on the crest of that prominent hill known as Fairy Hill. Serampore will probably before long have a set of offices for which a very favorable site on the river bank is available. If this policy is steadily maintained, Bengal will in the course of a few years have reason to be proud of its conveniences in the shape of public courts and offices.

## Current News.

A HOME paper announces that the law costs in the Deccan Mines Inquiry already come to £40,000.

THE survey of the Sind, Delhi and Rajputana projected Railway will, it is reported, commence after the rains.

THE Sind Arts College has secured the services of Mr. Moses J. Jackson, M.A., Oxon. and D. Sc. Lond., as Principal in succession to Dr. Walmsley.

MR. C. CHAMBERS, F.R.S., Director of the Government Observatory at Colaba, Bombay, takes privilege leave of absence for three months. Mr. F. Chambers acts for him.

IT has been decided to construct a pipe for the conveyance of petroleum from Khatun to Sibi, a distance of about forty miles. The cost is estimated at 2½ lakhs of rupees.

CAPTAIN Heathcote, R.E., on vacating his appointment as officiating Inspector of Army Signalling, Bengal, will be posted to the Rawlpindi Command, Military Works.

THE Madras Fine Arts Society intends to hold, about the 15th January next, an exhibition of pictures and other works of art, and Special Industries. Twenty-eight prizes will be offered.

BRIGADE SURGEON J. RICHARDSON, Sanitary Commissioner in the North-West Provinces, is granted leave for six months, and Surgeon S. J. Thomson officiates as Sanitary Commissioner during his absence.

THE Bombay Government are making inquiries into the question of the employment of women and children in local mills, the hours of work, and the age at which such persons are admitted to the factories.

MORE than eight-and-a-half inches of rain fell in Allahabad during the four-and-twenty hours ending at 8 A.M. on the morning of the 25th July, a downpour which has been only once or twice surpassed during the past twenty years.

IT is now settled that Colonel J. Stewart, Superintendent of the Saddle and Harness Factory at Cawnpore, will not return to India. Major Baddeley, R.A., who is officiating for him, will, it may be safely concluded, obtain the substantive appointment.

THE Government of India has sanctioned the rate for the half cost of clearance of the Indus Canals in the Dera Ghazi Khan District, levied from landowners, being fixed at Rs. 54,000 per annum for a term of five years beginning with the 1st April last.

As Colonel R. G. Woodthorpe, R.E., who succeeds Colonel M. S. Bell, R.E., as Deputy Quartermaster-General, Intelligence Branch, will be detained in England until October next, the officiating appointment will fall to Major H. A. Sawyer, Bengal Staff Corps.

NOR only the new Town Hall at Simla, but the new Viceregal Lodge has, it seems, suffered severely from the recent heavy rains. The roof of the new Palace has leaked to such an extent that the proposed occupation is likely to be postponed again for a few days, until repairs are effected.

THE Controller of Military Accounts, Bengal, has, in reply to a reference made to him by the Commissary General-in-Chief, intimated that English padlocks supplied by the Commissariat Department for doors, windows, &c., in hospitals and for magazines and forts may be purchased locally.

THE Departmental Committee appointed to inquire into the circumstances under which the Jubbulpore mail-train was derailed near Nasik has come to the conclusion that a rail was removed maliciously from the up line by some person or persons who up to the present have not been arrested.

AN attack was made on the 26th instant upon a party of Hazara coolies working on the Khojak Railway. The men were engaged on the roadway two miles beyond Chaman when a number of Afghans set upon them. Two Hazaras were killed, and one wounded. The bodies were brought into the Engineer's camp.

THE bridge which spans the gates of the Victoria Dock, Bombay, was somewhat seriously damaged by the Italian steamer running into it. The damage to the bridge and gate is estimated at Rs. 5,000. The bridge will have to be removed, and Mr. Walke, the Dock Master, is of opinion that it will be fully a month before it will be in position again.

THE Burma State Railway loses, for the time being, two officers, *viz.*, Mr. F. L. Brown, the Examiner of Accounts, and Mr. Rigg, the Deputy Manager, both of whom are gone on leave. Mr. Johns acts for Mr. Brown as Examiner of Accounts, and Mr. Hogarth, in addition to his own duties, as Personal Assistant to the Engineer-in-Chief, will have to do the work of Mr. Rigg.



A MEETING of the silk cloth-weavers in the city of Poona was held last week, when it was resolved that no weaver should use Bombay silk in the manufacture of silk cloth, but should employ country-made silk in its stead. A written agreement to the above effect was entered into, and it was provided that any infringement of the rule made the persons liable to a fine of fifty rupees.

THE Darjeeling paper reports that the late heavy rains in and near Darjeeling have caused more than one slip on the railroad, and it was thought at one time that passengers could not be carried through to Silligori without delay and inconvenience, and notice to that effect was issued. A little extra energy, however, was put on; the slips were cleared away; and the trains have been running all right and to time.

## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*

### INDIAN R. ES.' PENSIONS.

SIR,—Can you or any of your readers give me the date of the Circular in 1886 or 1887 admitting R. Es.' to Staff Corps sterling pensions.

Q.

### COMPULSORY RETIREMENTS.

SIR,—Can you tell me when the 50 years' rule was first introduced? I ask the question as I have lately heard it stated, on high authority, that Government always had the option of compulsorily retiring Executive Engineers at that age. I think the rule is of very recent date.

TREBOR.

### MORE JOBBERY.

SIR,—*Apropos* of the recent articles in your paper on the Sind-Pishin Railway, Captain B. Scott, R.E., C.I.E., has at last reaped his reward for his services on that line, and as usual at the expense of less fortunate Civil Engineers. In the last list of promotions in the Railway Branch, Captain B. Scott supersedes seven civilians who were previously senior to him.

It is consoling to know that merit sometimes meets with recognition even when an apparent act of injustice has to be committed.

C. E.

### ROSE FARMING.

SIR,—Referring to your notes on *Rose-farming*, in a recent issue of your Journal, I shall be very thankful to you for such information on the subject as would enable me to start an experimental Rose-farm. Since last year, I have been thinking of doing so, but want of practical advice has deterred me from carrying out my plans hitherto.

The principal points on which I seek information are:—

- (1.)—Which is the best spot in India for Rose-farming—especially whether Kashmir or Hazaribagh would answer?
- (2.)—Which is the best variety of Rose for yielding perfumery?
- (3.)—Which would be most profitable—manufacturing (a) Otto and Rose-water—or (b) essence of Rose for the handkerchief?
- (4.)—Which is the best book that gives practical instructions for extracting its perfume from the Rose?

F. A. PERROUX.

### GOVERNMENT VERSUS "INDIAN ENGINEERING."

SIR,—I have read your "Appeal to the Profession" and consider the decision to subsidise your rival is wrong, generally, and unjust to you in particular.

If I were the conductor of a paper, and I found public money used to subsidise my competitor to my injury, I should certainly not hesitate to remonstrate and state my grievance to the Government of India, and if necessary to the Secretary of State. But as I am not conducting a paper and am a Government official, I cannot of course advise you as to the course you should pursue with reference to a decision of Government. I do hope, however, that the result will not be serious to you.

My experience is that subsidised papers do not live long. They are subsidised only because the public will not pay for them—the public won't pay for them because they are not good enough. The payment of a subsidy always tends to make them worse instead of better—and their inferiority soon becomes so marked, that the subsidy is withdrawn.

These are the reasons why I trust that this shady business will not injure you.

NESTOR.

### THE COMING PUMP.

SIR,—The mining community this side of India is in throes in consequence of the announcement that a well-known Hydraulic Engineer is just now engaged in perfecting a pump which is destined to shelve those already in the market, and revolutionize the hitherto accepted theory and practice of Hydraulic Engineering. I cannot recall to my memory the name of this *rara avis* nor the principle which is supposed to form the basis of the wonderful pump. The shadowy impression received from a gentleman who seemed to know all about it, however, enables me to describe it to the best of my memory. The pump in question is said to be one in which a smaller body of water under pressure raises a larger one—unlike a hydraulic ram, in which the conditions are opposite.

This wonderful result is obtained, I am told, by the supplemental pressure imparted to the descending or forcing column of water by a surface steam force pump, to force an ascending column of water which acquires volume in excess of the forcing column in the proportion of 9 to 1 by vacuum formed at the foot of the pump as in ordinary pumps, or to put it more clearly, the action will be somewhat like that of an injector.

I wish this intrepid Engineer success; but, judging from the salient features of the pump as projected above, he will find the infallible laws of hydraulic a negative factor in the perfection and performance of his pump.

RANIGANJ.

LIFT-PUMP.

### "THE UNCOVENANTED."

SIR,—In a recent number of your paper you drew attention to the case of the Engineers of over 30 years of age employed on responsible work on a frontier Railway who were drawing less pay than if they had joined the Army or Medical Service. You might possibly have mentioned other services. Comparing my own service and pay, I find in the Burma list the following examples, and it must be remembered that all services do not draw Burma allowance, and consequently my comparison counts as if I were a step higher than I am.

Forest Department	one year less service	Rs. 100 more pay;
Police	Much less	same pay.

Also other appointments not filled by Covenanted Civilians, such as Collectors of Customs and Jail Superintendents. During the late discussion in the House on the Uncovenanted Service Bill, I note a remark was made that Uncovenanted servants could not expect the same terms as Covenanted servants. I am not aware that they ever expected the same, or thought of asking for them; but the discrepancy is surely rather large, considering that Staff Corps Officers have for many years done the work of Covenanted Civilians, and their ranks have recently been recruited from the P. W. D.; whilst it would hardly be feasible to turn a Covenanted Civilian into an Executive Engineer. The difference I find as under:

P. W. Officer	x year service,	pay Rs. 950
M. S. C.	"	2,750

Comparing my own service, I find Covenanted Civilians of less than a quarter of my service drawing the same pay.

The impression given to the House was that the Uncovenanted Service was composed principally of natives, and that the admission to it was by a broad and easy road, whilst that to the Covenanted Service was narrow and difficult. The Civil Service Exam. is no doubt the stiffest, and admission into, say, the Police Department does not involve any very high class education, but the P. W. D. *via* Cooper's Hill is by no means a path everyone can count on traversing, and the difference a difficulty between it and the Civil Service is not at all proportional to the difference of pay previously quoted. I used to think the P. W. D. was at the head of the branches of the Uncovenanted Service, but this is by no means the case, and unless something is done to aid promotion, it will soon be the worst paid of the lot.

KHYEL.

July 19, 1888.

### DUBERN'S ILLUMINATOR.

SIR,—With regard to testing by an analyser whether the illuminating light is really polarized or not, there is but little chance of doing that, as the lighting and polarizing is all internal and none but the reflected light by the object could be tested. Yet that much might under such circumstances be depolarized before reaching the analyser, and prove nothing. Strange, however, that the somewhat marked antagonism of "Microscopist" has not led him to detect the only point, to my knowledge, where there may be a doubt. This is, that polarization by simple reflection is generally accompanied by refraction as well as transmission of a certain part of the total light.

But as for other requirements *sine quid non*, I have taken care to prevent such refraction and transmission, and only kept the better angle of polarization, in the absence of that derivation of light, there is no saying with absolute certainty that the light is much polarized, since some collateral occurrences are wanting. I found it nowhere stated that those additional conditions were either useful or necessary; neither could I trace an experiment



either for or against the necessity of the angle of polarization being further supported by refraction and transmission of a certain part, in order to leave the remainder of light polarized, and as I have no leisure to try such an elaborate experiment of optics, that remains an open subject.

Moreover, that is no very great concern of mine, whether the ray that enters the body of the microscope is polarized or not: neither is there any need for that. Its duty is to be performed at the object before it emerges. Light in its polarized state was not in this case intended to reach the eye: if it did, no matter: if it did not, yet no matter. Provided that through this way of using light, I rid the object of some diffraction lines, at least on one side, that is all I cared to do. And I did not go into a course of "Optics," but used optics as subservient to a practical purpose in view. On reaching that purpose through the better angle of polarization, and finding that "live atoms" then appear in a similar way as ordinary objects do when lit by polarized light, it seems to me legitimate to conclude that the lighting is polarized. If not, well! then it is a happy delusion, since it helped to reach the purpose in view, for it prevents diffraction to a great extent.

I can but repeat that the figure representing the other points of optics is rigorously accurate and practically carried out, when the glass piece composing the illuminator is homogeneous and well polished.

Refraction has not been left out of consideration as set forward by "Microscopist." Where refraction might have taken place, it has been provided for and prevented. Let him please read again from line 22, page 291, of the 14th April *INDIAN ENGINEERING*, and the eight lines following. There is no occasion for "Microscopist" to say "as soon as his ray of light enters and emerges from etc., etc." It does not emerge any more, unless it be at the other end of the illuminator, where it is of no concern, hence there can be no refraction. Even  $12^{\circ} 47'$  is to spare before the critical angle is reached, after which angle, only some slight amount of light would emerge, till a good many degrees beyond which no mentionable light would emerge.

The emergence of rays to convey the image to the observer's eye is rendered possible only through the lighting ray being deviated or reflected in a different path to the one it had. The only light that emerges, but that should not, is the small amount diffused at the whitish spot of total reflection, from the want of perfect polish of the glass cover external or top surface: and that, just as well as some light irregularly reflected or diffused does not amount to much. So, practically it does not matter, and theoretically that has nothing to do with the discussion of the problem. Should "Microscopist" yet have any doubts after this, let him consider that ray *s c fig. I. if it did emerge*, would enter the objective with the sun's condensed rays full intensity and necessarily with such blinding blaze that the eye could not bear it one instant.

This lighting is so very intense, that a single white particle  $\frac{1}{1000}$ th of an inch in diameter within the field, acts as a mirror and throws such an amount of light into the body of the microscope, that it produces a similar effect as the sun at the horizon does on the stars: only some of the largest germs remain visible. Professor Abbe's opinion would no doubt be valuable as to the capabilities of the illuminator. But without going so far, are not facts better than opinions?

I have under my eyes the latest edition of "Beale's Microscope in Medicine": he has a fine large plate shewing human red corpuscles magnified to over one inch in diameter: it represents plain shaded surfaces, and he calls them "smooth circular bodies," the amplification is 2,800 diameters. In another of his books he mentions that he had at his disposal many years ago  $\frac{1}{100}$ th objective. Yet he did not modify his opinion or description. But the slightly beaded appearance of the edge with the  $\frac{1}{8}$ " and a low power eye-piece cannot have escaped his notice. Apparently the doubt as to its actual constitution was not removed enough to set it and illustrate it such as most distinctly shewn by the illuminator. He rather trusted the view of his higher powers, which shews it smooth and most likely considered the slightly visible beads, as markings arising from diffraction, for he left the matter alone, as may be seen in his latest edition.

The latest book procurable on the Microscope (1886), after a good deal of considerations on blood corpuscles, human red blood corpuscles, etc., etc., on the same subject, speaks of nothing on the matter of internal structure.

Recent Journals of the Microscopical Society (London) represent red corpuscles as Beale does. A treatise on Physiology calls the human red corpuscle a "structureless and transparent filmy frame work" and shews some very small dots in the one of the frog after treatment by acetic acid.

Finally, the more recent article I have on the matter, an extract from the *American Naturalist* dated August 1887, goes into most minute details and tests to ascertain the real constitution of the human red corpuscle: yet none of the above mentions as a distinct and settled point, or indeed, in any way at all, the most distinct 14 or 16 live atoms or motile spheres which are symmetrically set all around its periphery, thus leaving a most important point undecided. Moreover, Beale, at page 259, states that the red blood corpuscles, when finally formed, or constituted, are dead.

The illuminator leaves no doubt on several of the character-

istics, and shews plainly enough that every one of them are distinctly alive and constituted of some of the live atoms, micrococci, spores, cocobacteria, or whatever name be preferred for them (that are in the serum), for micrococci, spores or spheroidal bacteria are shewn by the illuminator to be one and same thing: all the above refers to fresh blood corpuscles from healthy animals' blood, uninterfered with, and as they are during the first twenty-four or thirty-six hours that they remain apparently unmodified and alive in sealed cavities from the time of extraction.

Neither do any of the above authors speak of the *extremely* numerous live atoms, micrococci, spores or of anything of the sort in fresh limpid serum, or in any way, point to that probable origin of those parts eventually found in the blood corpuscles. But only some small granules, fat globules and white corpuscles, altogether comparatively few in number, are recorded as seen in it. With the  $\frac{1}{4}$ th immersion objective and ordinary lighting, I can see something, but under such delusive appearance and such unsatisfactory way as to prevent correct appreciation of actual state, and far from perceiving the most important part that micrococci play in the constitution of blood or its physiological economy, or in the economy of plants.

Presence of micrococci is and was years ago demonstrated in almost every earthly object, but as *parasites*. However, Buffon, under the denomination of Monads, as a matter of speculation, considered them as *contributing* to the formation of plants and animals. Oken was subsequently of the same opinion, relatively to formation of even the larger animals, but in the same page, quoting the last, it is stated that modern science has completely overthrown all that though supported by Descartes, Kepler and Gassendi. The famous naturalist Bonnet supported such views again: so did Count d'Auvray. But such scientific man as Pouchet, a quite modern *savant*, scoffs at the idea that spores (live atoms) resist boiling for hours or red heat. What would he say to nitro-hydrochloric acid micrococci, in a living state in it for over twelve months, or to live micrococci direct from incandescent carbon just extinguished before being submitted to trial. The acme of crazy speculation would be but mild qualificatives, and falsehood or downright blundering, the only way suitable to describe such trial or experiments, in his estimation.

Here the illuminator can step in, and experimentally prove the major part of those speculations as correct, and further shew such live atoms *at work* in such amazing quantities before and after aggregation of several, as to leave no room but for the conclusion that they are necessary constituents, just as well as prime movers. And if bacteria is the denomination adhered to, as the very same, are classified in Microscope text books, well then, our blood is simply swarming with bacteria and we are feeding on enormous living numbers of them to be found in the purest water and air at any moment and anywhere: that other part of our food, bread, being composed about half by half of still ones and living ones, whilst boiled meat hitherto appears as composed of still ones or micrococci shells, and the inevitable conclusion is, that we are mostly made up of bacteria or of their shells (the red corpuscle being analogous to an infusoria) similarly to a great deal of the earth's crust, as is well known. But of course such micrococci as primary food to us may be more or less healthy or contaminated, according to different supplies or localities.

If mostly healthy or purer, such as on high hills, that peculiar human animalcule called blood corpuscle would mostly be the result; if unhealthy or contaminated, some proportion of ordinary bacteria or infusoria, *i.e.*, true parasites, would be the result, and disease the consequence of a more or less virulent character, if not starved out or thrown out by the healthy one's preponderance.

A curious direction in which the process of life evolution points to, as seen through the illuminator, is that Koch's cholera bacillus is rather one product than the germ or cause of cholera.

All authors are unanimous as to the necessity of the best and highest powers of the microscope, to observe or find at all micrococci. Is not the fact that the illuminator enables a five rupees worth microscope having a power of fifty or sixty diameters only (single lens objective) to shew them distinctly, worth any amount of opinions.

So far as the present amount of available evidence goes, the lenses of those appliances, "*of the capabilities of which I can scarcely form a conception*" (to quote "Microscopist's" own words)—had better be wiped clean of their foggy surface to try and approach this searching and resolving power of the illuminator. But let this little bit be taken in its mildest sense by "Microscopist."

Will he enlist the best microscope procurable in Calcutta in a tournament against the above-mentioned five rupees worth microscope, with the object of detecting micrococci in plain filtered Municipal water and shew them in larger quantities which it should do easily. He may use all powers and appliances he pleases, except the progenitor lighting of the illuminator, as described in *INDIAN ENGINEERING* of 7th April 1888: nor the illuminator shewn at page 184 (Hogg), except as exactly therein represented, for this illuminator now shews another way of using that one to enable it do a great deal more than it could hitherto, if now used so as to stop transmission of lighting rays which there, are shewn emerging; neither is coloring to be used, not itself passed free from colored micrococci, as it would be too easy to shew something after putting it in.



## General Articles.

## TELEGRAPH OFFICE, CALCUTTA.

THE Telegraph Office, Calcutta, which is the head-quarters of the Telegraph Department in India, forms the subject of our architectural illustration this week. All visitors to Calcutta are acquainted with this building—for naturally it is a place nearly everyone resorts to at some time or another: and it is also conspicuous on account of its colored façade and the angle tower, which has not been made to serve its original purpose.

Begun about the year 1867, from designs made under the superintendence of Mr. Granville, who was then Government Architect, and drawn out by Mr. Benjamin Clark—with modifications and improvements by Mr. W. Barnfather—it was completed in 1870.

Mr. Geo. Vivian had charge of the work at its commencement, and Mr. Leonard Robert, Mr. Barnfather and Mr. Sills were successively appointed to superintend the building. Mr. W. Macgregor, Sub-Engineer, was the local clerk of works, and Mr. W. Smith, the Superintending Engineer. It was here that several of the passed Civil Engineering students of the Presidency College received their practical training.

The foundations were built upon most unusually good and uniform soil for Calcutta, and as a result the structure has stood, as far as we know, without a crack.

The general construction of the building was well carried out, and the finishing up very creditable.

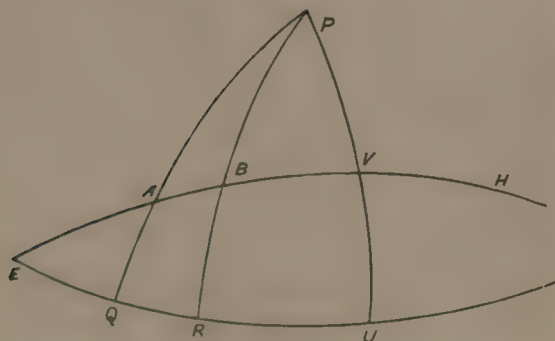
These offices are well worth a visit, and is a good example of an extensive building upon a limited site.

## NOTES ON NAVIGATION.

By A. EWBANK.

II.

Fig. 2.



In fig. 2 E Q R is the equator and P the north pole. E A B H is a great circle, and E V = 90°. This point V is in nautical text-books called the vertex. The term as applying to V does not belong to the general language of mathematics.

E A Q is such a spherical triangle as we have already discussed. Q is the right angle, and if E B is an arc less than a quadrant, as the figure implies, the angle E B R will be acute. The angle A E Q is acute by hypothesis. In other words, we take a great circle E B, which is not a meridian, and moreover we confine ourselves to that portion of the great circle E B which is north of the equator. Any conclusions we may obtain with regard to navigation problems on the arc E V will, *mutatis mutandis*, apply to the other three quadrants of the circle E B.

If a ship sails or steams along the great circle E A B, then at A her course or path makes a certain angle P A B = E A Q with the true due north direction at A. This angle P A B we shall call the "course" of the ship. We shall not take account of compass errors, for our present inquiries have no relation to magnetism. Thus, if we ever refer to a compass, we mean an ideal compass which always points towards the geographical north pole. Our reasonings are not thereby "impractical"—to use a common word—because an ordinary compass duly corrected is in fact the compass we mean.

Now, if a vessel is to move along the arc A B towards B, her "course" must continually increase by infinitesimal changes. The angle P B V exceeds the angle P A B. Thus the compass would have to indicate a gradual and unceasing increase of deviation from the true north direction.

It would be impossible for a sailor to know what these imperceptible changes are, and, if he did know them, he could not manipulate the helm with sufficient delicacy to carry out the plan of keeping the head of the vessel always pointed in the new and proper direction. Sailors therefore *never* attempt to travel along such a great circle as E A B.

We have assumed that the angle P B V is greater than the angle P A V. This, if thought necessary, may easily be proved. Let us apply equation (1) to the triangle P V B. Thus

$$\sin P V = \sin P B \cdot \sin B.$$

Similarly in the triangle P V A

$$\sin P V = \sin P A \cdot \sin A$$

$$\therefore \sin P B \sin B = \sin P A \sin A$$

Now the arc P A > arc P B and both are acute

$$\therefore \sin P A > \sin P B$$

$$\therefore \sin B > \sin A$$

And the angles B and A are acute

$$\therefore B > A.$$

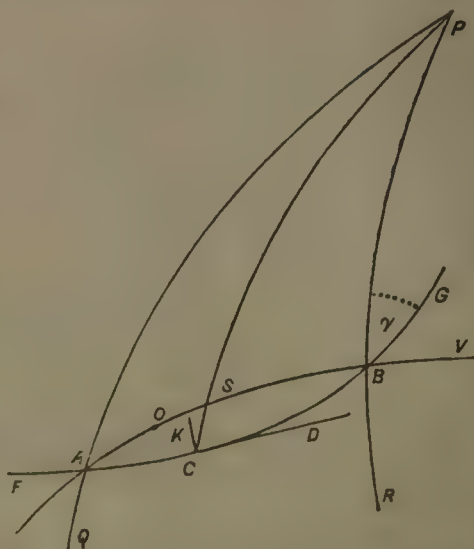
Among the numerous class of steamship passengers we find a general belief that steamers travel on arcs of great circles. Lately a traveller in defending this belief used the following illustration. On a level road let a straight line be chalked out, and let a skilful bicyclist be asked to run his machine along it. He will not be able to do so exactly, but he will do so nearly. In the same way, a steamer may be unable in consequence of currents or side-winds to keep the great circle exactly, but she will do so nearly.

Such an illustration is utterly fallacious. The skilful bicyclist will keep pretty near to the track laid out, whether it be a straight line, or some gradual curve. His deviations from the line will sometimes be on one side and sometimes on the other. His actual path will cross and recross the laid out track many times in the course of a mile.

But if A be a port of departure, and B be the harbour for which the ship is bound, the ship in leaving A will leave the great circle A B and will not strike it even once in the space of fifty miles.

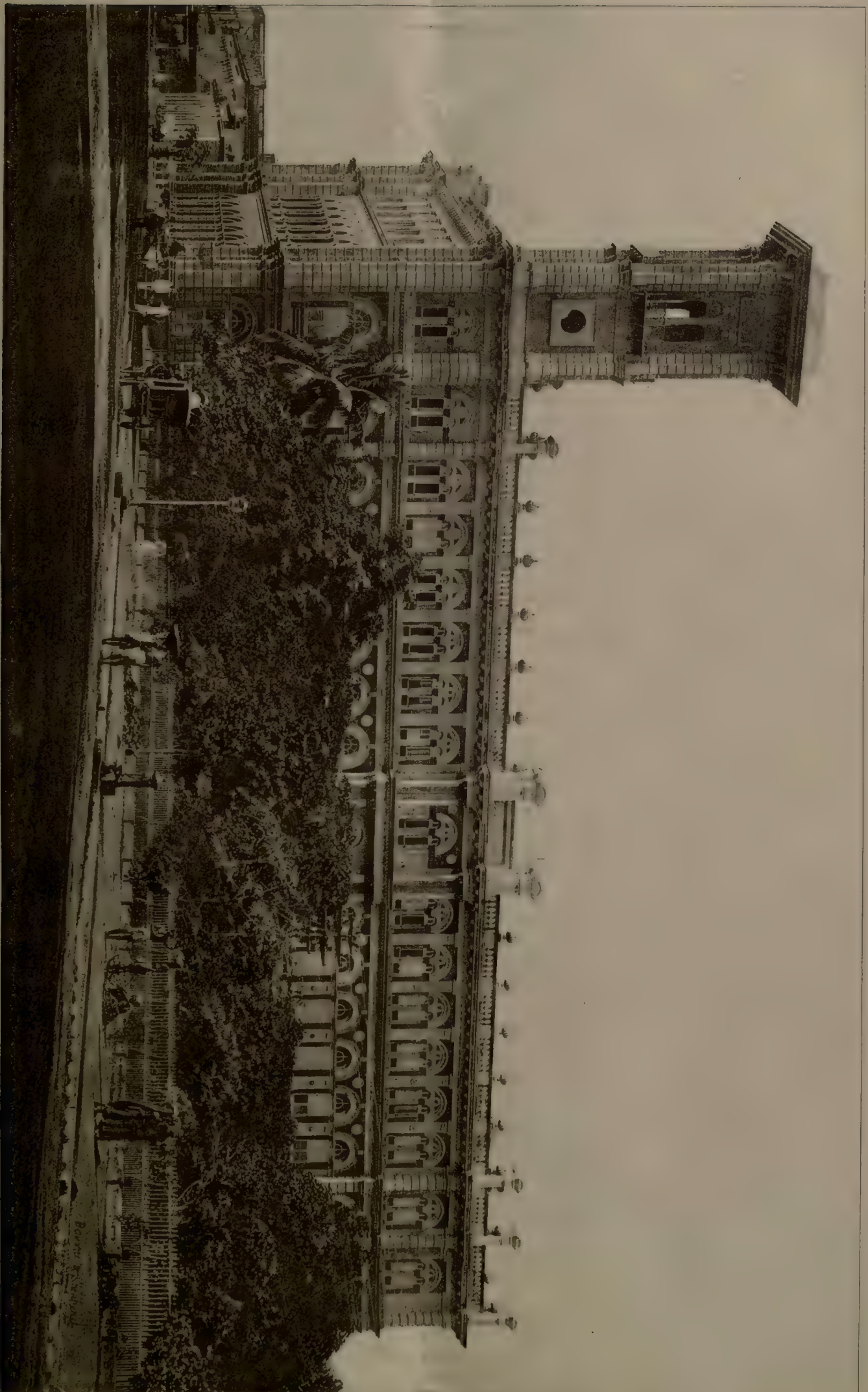
There is a curved line on the sphere which corresponds to the track prescribed for the bicycle. Along this curved line the ship will try to move, and all deflections from it will be accidental like the sinuous deviations of the bicyclist. This curved line on the sphere is called a rhumb line. The whole series of the present papers might have been described as a monograph on the rhumb line. The word monograph, however, generally connotes an extensive study, and hence the humbler title of "Notes" was preferred.

Fig. 3.





INDIAN ENGINEERING.









In *fig. (3)* we have the same great circle  $AB$  as in *fig. 2*. Since the angle  $PAV$  is less than  $PBV$  it is possible to find more than one value for an angle  $\gamma$  such that  $\gamma$  shall be greater than  $PAV$ , and less than  $PBV$ . In *fig. (3)* is drawn a curve line  $FABG$ . It cuts the great circle  $AB$  at  $A$ . Between  $A$  and  $B$  the new curve is south of the great circle. Beyond  $B$  the new curve begins to be, and continues to be, north of the great circle.

The new curve is such that the angle at  $A$  between the meridian  $AP$ , and the direction of the curve measured towards  $C$  is  $\gamma$ . The same angle is found at  $B$  between the meridian  $BP$ , and the direction of the curve measured towards  $G$ .

Let  $C$  be any point between  $A$  and  $B$ , and on the rhumb line  $ABG$ . At  $C$  and in the plane  $CP$  draw  $CK$ , the tangent line to the circle  $CP$ . At  $C$  draw  $CD$ , the tangent line to the rhumb line. This line  $CD$  is drawn to the right hand in the figure. Let a small particle travel along the rhumb line from  $A$  to  $B$ . Then at  $C$  it is for a moment moving in the direction  $CD$ . For all positions of  $C$  the angle  $KCD = \gamma$ . This is the characteristic property of a rhumb line. A ship sailing along  $ACB$  has a constant compass direction. What is called her "course" is constant. This course is the angle  $\gamma$ . Throughout these papers the Greek letter  $\gamma$  will be reserved to denote the constant course along a rhumb line.

If  $A$  and  $B$  are given points, and it is required to determine the angle  $\gamma$ , there is only one value of  $\gamma$  that is suitable. An unlimited number of rhumb lines can however be drawn, all starting from  $A$ . If we choose an acute angle  $\delta$  greater than  $PAO$ , where  $AO$  is the great circle  $AB$ , but take  $\delta$  less than  $\gamma$ , the rhumb line so determined will cut the great circle  $AB$  between  $A$  and  $B$ . If we choose an acute angle  $E$  greater than  $PAO$ , and also greater than  $\gamma$ , we shall have a rhumb line cutting the arc  $AOB$  produced. If we choose an angle  $\phi$  slightly less than  $PAO$ , the rhumb line in leading  $A$  starts at once to the north side of the great circle  $AOB$ . Such a rhumb line produced downwards or southwards will cut  $BA$  produced.

If the rhumb line angle is reduced to zero, the rhumb line becomes the meridian  $PA$ . If the rhumb line angle is increased to  $90^\circ$ , the rhumb line becomes the small circle of latitude passing through  $A$ .

Now suppose the earth covered with water—say 50 feet deep everywhere. Let the temperature everywhere be above the freezing point of salt water. Then we may imagine a steamer starting from  $A$  and moving continually on one rhumb line  $ACG$  with a constant rapid velocity. In such a case where will the steamer finally be found? Our rhumb line is such that  $\gamma$  is an acute angle—say  $60^\circ$ .

Such a path for the steamer will meet the meridian  $AP$  at a point in the arc  $AP$  produced. On continuing its motion the steamer will again meet  $PA$ . This time the point in  $PA$  will be like the point  $L$  in the figure. The steamer has now in respect of longitude made a complete circuit round  $P$ .

On continuing in the rhumb line for another quasi-circuit, the steamer will reach a point between  $L$  and  $P$ . On making a very great number of such circuits, the steamer will ultimately be very near to the north pole. If a man sufficiently elevated above the north pole could watch the steamer throughout these movements, he would see her describing a sort of spiral, of which  $P$  is a kind of centre.

PREPARATIONS are being made in Batavia for laying a direct line of submarine cable from Java to the port of Macassar.

THERE is a probability, in the event of the difference of opinion between the India Office and Indian Governments on the subject of the working of the proposed Kalka-Umballa-Delhi Railway, not being settled to their mutual satisfaction, that the line from Umballa to Kalka only may be undertaken as a State project.

## PAPER MANUFACTURE IN BURMA.

ALTHOUGH this industry was so ably advocated by many eminent authorities, as a certain profitable investment, supported as it is by the natural facilities afforded by the country abounding in paper stock and fibres, still we are surprised to find that this industry was not taken up by an European but by a Chinese firm; who, although not turning out special classes of writing paper, do a very remunerative business in supplying the local wants of their community, as also supplying the local bazars with large quantities of good brown paper.

The machinery and appliances used are those manufactured by Messrs. Bushbridge & Co., and the concern is solely worked by Chinamen. The mills, &c., appear to be of the most approved kind, worked on a systematic basis, not unlike the English principle. The operation first begins by sorting the rags, after which they are cut up into shreds and placed in a perforated cylinder, which is about 8 feet in length by 3 in diameter, and fixed at an incline of about  $10^\circ$ . The driving shaft is fixed with spokes of about 6 inches in length, fixed at right angles to its axis, which cause the rags to be turned round and beaten during the rotation; and as the revolution is rapid, and the cylinder being encased all round, enables the spokes to carry the rags at each turn nearer the outlet, where they are received and bagged by an attendant. The next process the rags undergo is boiling down for three or four hours in a strong solution of caustic; which operation not only cleanses them, but separates and loosens the shreds—very essential in colored rags—also serving the double purpose of destroying foreign bodies, such as woollen or other fibrous material. After the elimination of foreign matter the contents are transferred into a washing cylinder—the bottom part of which revolves with a running stream of water, where they undergo partial cleansing, when they are again transferred to a boiler for further cleansing. This rag boiler is a large barrel-shaped vat, lined with lead, about 6 feet in length, and has a partition in the centre to about three-quarters of its length. On one side of the partition is an iron roll, around which are studded 1-inch blades, so placed to be parallel with its axis. On the other side, underneath the boiler, is placed a block of wood fitted with cutters, and hollowed out, to allow the iron roll easily to revolve. As soon as the boiler is well filled with the prepared rags, a stream of water is admitted, and the boiler made to revolve for two hours in a continuous stream of water; which operation reduces the rags to a pulp, which is removed and drained in a large tub. The next process is that of bleaching, which is conducted in a large cask of water mixed with chloride of lime, to the extent of 3lbs. to each cwt. of rags, and when the contents are found sufficiently bleached a few ounces of antichlor is used to destroy the traces of chlorine; the stuff is then taken out and sorted, and placed under different heavy presses, where it is issued according to the quality of paper required by the attendant at each press. A very important feature in the manufacture of paper is the use of clean water, as the color of the paper depends entirely on the purity of the water, and it is therefore very essential that the water used in the different processes be filtered by the most economical means at hand. The last and final process the pulp undergoes before being manufactured into paper is, that the bleached stuff from the presses is transferred into a beating machine, each quality in turn. The internal parts of this machine are similar to the shredding machine, but all the operators are made finer, by which the pulp is reduced to the consistency of a paste, and allowed to run into an adjoining box connected with the paper-making machine; here the paste undergoes incessant agitation, and when all uneven substances are entirely removed, it rapidly finds its way through a number of channels until it arrives on an evenly fitted wire gauze, where it is lightly skimmed over by rollers to give it a fine evenness; at the same time thoroughly drained of the



water. In this manner the paste passes over several feet of the platform wire gauze, drying as it advances, when it assumes the appearance of paper, and finally is subjected to the pressure of another roller covered with felt, underneath which is placed a steady slow heat, produced by means of hot air blown in through tubes by a fan specially designed for the purpose, until the sheets of paper are thoroughly dried, when they are cut up into smaller sheets and packed into reams.

We believe the above description is the same, with very little difference required in the preparation of fine writing paper.

There is a special process of preparing pulp from fibres by which the paper used exclusively and so extensively by Chinese in book-keeping and correspondence, of a dark straw color, but very strong, much resembling Bally Mill-made paper, is made. The fibre is first steeped in stagnant water and allowed to undergo fermentation; under this process all the vegetable constituents of the fibre get decomposed and render the remaining ligneous fibre for the production of pulp much easier, and the operation of bleaching more effective. After this treatment the prepared fibre is treated to a warm solution of alkali, which entirely destroys any remaining vegetable matter that may be left. The time necessary for the production of pulp greatly depends on the temperature of the solution, also the nature of the fibre operated on, as the higher the temperature the shorter the time necessary for the production of clean fibre.

H. T.

## THE SEWERAGE OF THE FORT OF MYSORE.

BY STANDISH LEE,

Sanitary Engineer, Mysore State.

### V.

#### PRIVIES AND URINALS.

THESE are illustrated on Plates XIII. and XIV. They are of the best types as yet introduced into India and they are adapted to the customs of the country.

*Abstract estimate of the probable cost of the Palace portion of the scheme, which is to be met from Palace Funds.*

Quantity.	Particular.	Rate.	Amount.	Total.
		Rs. A. P.	Rs. A. P.	
15,940	R. ft. of 3 in. Glazed stone-ware drain pipes in straight lengths ..	0 5 0	991 0 0	
940	Do. 4 in. do. do. ..	0 5 0	398 0 0	
1,337	Do. 6 in. do. do. ..	0 7 0	585 0 0	
458	3 in. Single junctions for house-drains ..	1 8 0	687 0 0	
29	4 in. do. do. do. ..	2 0 0	58 0 0	
30	6 in. do. do. do. ..	2 8 0	75 0 0	
364	R. ft. of 3 in. Glazed stone-ware drain pipes for lamp-holes and ventilating shafts (under ground) ..	0 5 0	114 0 0	
16	3 in. 1 bends ..	0 12 0	12 0 0	
24	Stone-ware disc plugs, 8 for each kind of pipes, with finger holes ..	1 0 0	24 0 0	
42	3 in. 1 on rain water pipes with fittings, in 6 ft. 1 lengths for ventilating shafts (above ground) ..	1 10 0	60 0 0	
900	R. ft. of 3 in. Glazed stone-ware drain pipes for Palace ..	0 5 0	300 0 0	
40	Bends for Palace ..	0 12 0	30 0 0	
40	Gully traps for Palace ..	3 0 0	120 0 0	
25	3 in. Iron rain-water pipes with fittings, in 6 ft. lengths for ventilating shafts in Palace ..	1 10 0	41 0 0	
3	Cowls ..	15 0 0	45 0 0	
3	Cast iron ventilating grates with movable plugs ..	82 0 0	246 0 0	
3	Cast-iron combined man-hole and movable grate ..	132 0 0	396 0 0	
2	Field's flushing tanks ..	182 0 0	364 0 0	
1	Flushing man-holes 6 ft. deep ..	40 0 0	120 0 0	
1	Do. 5 ft. " ..	36 0 0	36 0 0	
2	Do. 4 ft. " ..	33 0 0	66 0 0	
3	Man-holes 8 ft. deep ..	37 0 0	111 0 0	
2	Do. 8 ft. " ..	88 0 0	66 0 0	
9	Do. 7 ft. " ..	30 0 0	270 0 0	
10	Do. 6 ft. " ..	28 0 0	280 0 0	
20	Do. 5 ft. " ..	24 0 0	480 0 0	
10	Do. 4 ft. " ..	21 0 0	210 0 0	
9	Do. 3 ft. " ..	20 0 0	180 0 0	
67	Tons, freight by native craft from Bombay to Cannanore including shipping charges, bunker fees, and cart hire from Cannanore to Mysore ..	22 0 0	1,474 0 0	
4,800	C. yds. of Excavation of earth for pipe-tracks, refilling after laying the pipes, and properly ramming and dressing the surface ..	0 5 0	1,500 0 0	
16,077	Elab stones for carrying pipes over soft ground ..	Lump.	200 0 0	
1,273	R. ft. of laying and jointing 3 in. and 4 in. stone-ware drain pipes in 2 ft. working lengths, including cement, &c. ..	0 1 0	1,005 0 0	
	Do. do. 6 in. do. ..	0 2 0	160 0 0	
	Removing and rebuilding masonry house-connections in the Palace ..	Lump.	100 0 0	
	Superintendence and Sundries ..	....	1,257 0 0	
	Grand Total Rupees ..	....	....	16,000
	Deduct cost to be charged to Palace funds ..	....	....	3,000
	Net cost of the Public Street service, <i>Sewage-farm.</i> ..	....	....	13,000
	Compensation for 5 acres of land with buildings thereon ..	....	1,500 0 0	
	Fencing, leveling, grading and laying down pottery tiles for drains for grass plots Rs. 240 per acre ..	....	1,200 0 0	
3	Picottas with masonry work, etc., complete, for raising sewage at Rs. 100 each ..	....	300 0 0	
	Total Rs. ..	....	....	3,000
	Grand Total Rs. ..	....	....	16,000

## Abstract estimate of probable cost of the Palace and Public Street portion of the scheme.

Quantity.	Particular.	Rate.	Amount.	Total.
		Rs. A. P.	Rs. A. P.	
15,940	R. ft. of 3 in. Glazed stone-ware drain pipes in straight lengths ..	0 5 0	991 0 0	
940	Do. 4 in. do. do. ..	0 5 0	398 0 0	
1,337	Do. 6 in. do. do. ..	0 7 0	585 0 0	
458	3 in. Single junctions for house-drains ..	1 8 0	687 0 0	
29	4 in. do. do. do. ..	2 0 0	58 0 0	
30	6 in. do. do. do. ..	2 8 0	75 0 0	
364	R. ft. of 3 in. Glazed stone-ware drain pipes for lamp-holes and ventilating shafts (under ground) ..	0 5 0	114 0 0	
16	3 in. 1 bends ..	0 12 0	12 0 0	
24	Stone-ware disc plugs, 8 for each kind of pipes, with finger holes ..	1 0 0	24 0 0	
42	3 in. 1 on rain water pipes with fittings, in 6 ft. 1 lengths for ventilating shafts (above ground) ..	1 10 0	60 0 0	
900	R. ft. of 3 in. Glazed stone-ware drain pipes for Palace ..	0 5 0	300 0 0	
40	Bends for Palace ..	0 12 0	30 0 0	
40	Gully traps for Palace ..	3 0 0	120 0 0	
25	3 in. Iron rain-water pipes with fittings, in 6 ft. lengths for ventilating shafts in Palace ..	1 10 0	41 0 0	
3	Cowls ..	15 0 0	45 0 0	
3	Cast iron ventilating grates with movable plugs ..	82 0 0	246 0 0	
3	Cast-iron combined man-hole and movable grate ..	132 0 0	396 0 0	
2	Field's flushing tanks ..	182 0 0	364 0 0	
1	Flushing man-holes 6 ft. deep ..	40 0 0	120 0 0	
1	Do. 5 ft. " ..	36 0 0	36 0 0	
2	Do. 4 ft. " ..	33 0 0	66 0 0	
3	Man-holes 8 ft. deep ..	37 0 0	111 0 0	
2	Do. 8 ft. " ..	88 0 0	66 0 0	
9	Do. 7 ft. " ..	30 0 0	270 0 0	
10	Do. 6 ft. " ..	28 0 0	280 0 0	
20	Do. 5 ft. " ..	24 0 0	480 0 0	
10	Do. 4 ft. " ..	21 0 0	210 0 0	
9	Do. 3 ft. " ..	20 0 0	180 0 0	
67	Tons, freight by native craft from Bombay to Cannanore including shipping charges, bunker fees, and cart hire from Cannanore to Mysore ..	22 0 0	1,474 0 0	
4,800	C. yds. of Excavation of earth for pipe-tracks, refilling after laying the pipes, and properly ramming and dressing the surface ..	0 5 0	1,500 0 0	
16,077	Elab stones for carrying pipes over soft ground ..	Lump.	200 0 0	
1,273	R. ft. of laying and jointing 3 in. and 4 in. stone-ware drain pipes in 2 ft. working lengths, including cement, &c. ..	0 1 0	1,005 0 0	
	Do. do. 6 in. do. ..	0 2 0	160 0 0	
	Removing and rebuilding masonry house-connections in the Palace ..	Lump.	100 0 0	
	Superintendence and Sundries ..	....	1,257 0 0	
	Grand Total Rupees ..	....	....	16,000
	Deduct cost to be charged to Palace funds ..	....	....	3,000
	Net cost of the Public Street service, <i>Sewage-farm.</i> ..	....	....	13,000
	Compensation for 5 acres of land with buildings thereon ..	....	1,500 0 0	
	Fencing, leveling, grading and laying down pottery tiles for drains for grass plots Rs. 240 per acre ..	....	1,200 0 0	
3	Picottas with masonry work, etc., complete, for raising sewage at Rs. 100 each ..	....	300 0 0	
	Total Rs. ..	....	....	3,000
	Grand Total Rs. ..	....	....	16,000

(To be continued.)

## NOTES ON THE POSITIVE CYANOTYPE PROCESS OR METHOD OF REPRODUCING WITH DARK LINES ON A CLEAR GROUND, FACSIMILE COPIES OF DRAWINGS, PLANS AND TRACINGS.

COMPILED IN THE PHOTOGRAPHIC OFFICE, SURVEY OF INDIA DEPARTMENT, CALCUTTA.

THE following method of reproducing plans, tracings, &c., drawn in black ink on white paper or tracing cloth, is known as the "Positive Cyanotype Process," and has the great advantage of giving copies of the drawing reproduced directly in dark blue lines on a white ground, while, unless a photographic negative be used, the negative cyanotype process gives prints with white lines on a dark ground, which are not so easily legible as the positive prints, though the process is simpler. Both methods were the invention of Sir John Herschel, but have been improved and perfected by Poitevin, Marion, Pellet and others in France, and the positive process is now more commonly known by the names of *Cyanotype* and *Gum-moferrique*, which have been given to it in that country.



# PLATE NO. XIV.

Fig. 1.  
Pipe junction.

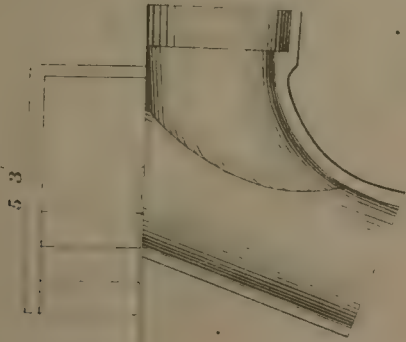


Fig. 2.  
Pipe junction.

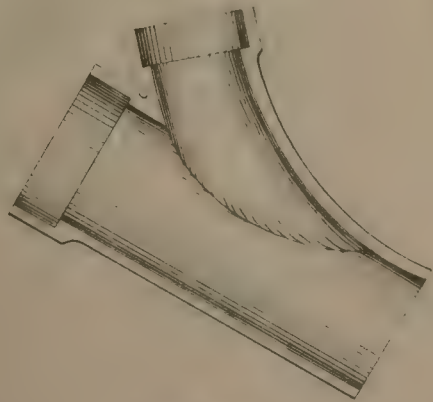
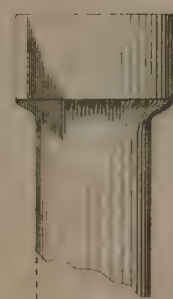
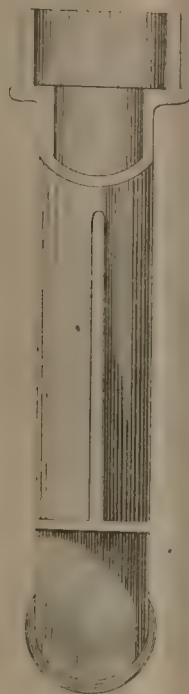
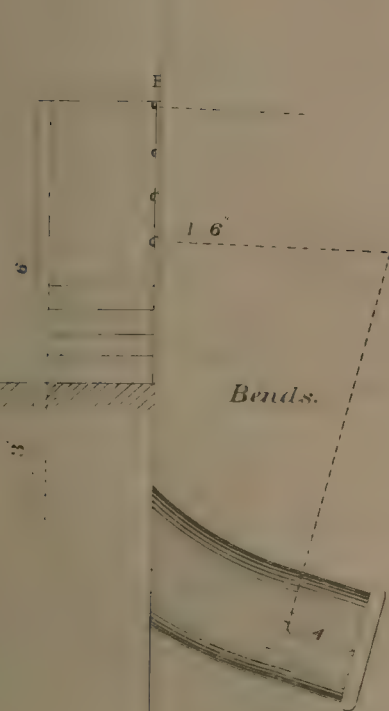


Fig. 3.

Fig. 4.

Ventilating Cast-iron Pipes.



Section. C. D.



C-D  
Lug.

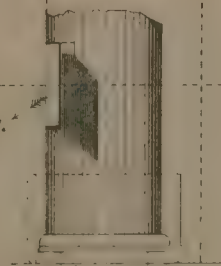


Fig. 5.

Sluice Spindle Key

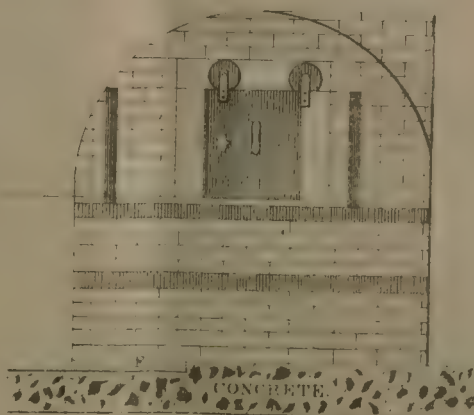
Screw driver



Man-hole key

Fig. 6.

Mr. Stafford's Refuse Destructor.









**Apparatus.**—The apparatus required is simple, and consists of a pressure frame with plate glass, similar to those used for ordinary photographic work, and large enough to take the largest tracing or drawing required. The back-board should be jointed in three and have three cross-bars. In large frames four or five cross-bars may be necessary. A piece of felt or thick flannel should be cut to the size of the frame and kept with it. In place of the felt a few sheets of clean soft paper may be used.

The glass of the frame should be kept clean on both sides and free from scratches, and the felt or paper pads should be kept thoroughly dry, and be well aired in the sun before use.

With printing frames of large size, it may be convenient to mount them on a pivoting stand, so that they can readily be placed at any angle perpendicular to the sun's rays, or turned face downwards while being run in and out of the dark-room or during the examination of the test slips.

Sometimes, instead of a wooden pressure frame, a thick plate of glass only is used, supported on an India-rubber air cushion, the pressure of which against the glass gives very perfect contact.

It has also been proposed to obtain close contact in a simple way without the use of glass plates or frames, by stretching the sensitive paper and tracing over a cylinder. The cylinder has, however, to be kept turned during the progress of the exposure. For work up to the size of a double elephant sheet, the pressure frame will probably be the most convenient arrangement.

**Dishes and Trays.**—At least three trays will be required for chemical solutions and washing; but it is strongly recommended to have four, so that each tray may be kept for a special purpose. Two of the dishes intended for chemicals may be made of *papier maché*, or of wood lined with gutta-percha or India-rubber. As India-rubber and gutta-percha do not stand the Indian climate well, it will be better to use trays made of wood well varnished with shellac varnish, or a composition of—

Asphaltum	...	...	7lb.
Beeswax	...	...	2lb.
Linseed oil	...	...	1 pint.

Before the varnish is dry, the tray is well lined with strong linen cloth, and then coated again two or three times with the varnish. According to Fisch (*La Photocopie*) trays lined with lead may be used for the prussiate and acid baths. Where the arrangements are fixed these will perhaps be the most convenient, specially for work of large size. The lead might be varnished with advantage, and the coating renewed as necessary.

The other two trays, used for washing the prints, may be made of strong sheet zinc or of wood lined with zinc. For these two trays, water-supply, with pressure of at least five or six feet, will be necessary, and should be led into them by India-rubber tubes about one inch in diameter, and not quite long enough to reach to the bottom of the trays. The taps may be fixed about 18 inches above the troughs, and the India-rubber tube be from 10 to 15 inches long. A rose may be attached to the end of the rubber tube, but it is better to have an additional rose jet as noted below.

All the trays should be about three or four inches deep, so as to allow room for about one inch depth of fluid without fear of splashing over. The zinc trays should be occasionally scoured with fine sand and a little solution of potash or soda.

It will be convenient to have the four trays arranged in order, as shewn in the diagram, at a height of 2½ to 3 feet from the ground—

1	2 + tap.	3	4 + tap.
Prussiate bath.	Water bath.	Acid bath.	Water bath.
	• +		• +

\* Tap with rose.

\* Tap with rose.

It will also be found a convenience in washing to place an additional tap at the right hand corner of the washing trays, fitted with a foot or two of half-inch rubber tube, carrying at the other end a copper rose with a bent neck about 6 or 8 inches long, which may be held in the hand so as to direct the water jet all over the sheet and thus remove the gummy coating without brushing.

It is recommended that a sheet of plate glass should be placed in the zinc tray so as to obtain a perfectly level surface, which will facilitate the brushing and require less water. It is more easily kept clean than the zinc.

For preparing the sensitised paper, a flat board or, better, a sheet of glass provided with clips, for holding the paper while being coated with the sensitised solution, will be necessary. Also some broad soft camel or badger-hair brushes for coating the paper and clearing the prints. Thomson's patent damping brushes, which consist of a piece of fine felt fastened round a flexible wedge-shaped piece of India-rubber attached to a handle, are very suitable for applying the sensitive solution. If these cannot be obtained, a brush may easily be made by fastening some velvet or felt on to the wooden handle of an ordinary 4-inch damping brush.

Some glass measures, funnels and suitable vessels for mixing and holding the various solutions will be necessary. Also some stoneware jars or wooden tubs in which to prepare the acid and prussiate solutions in quantity, and some stoneware funnels for filtering these solutions when necessary.

A Baumé's hydrometer for heavy fluids will be useful for ascertaining the strength of the perchloride of iron and prussiate solutions. It should also be graduated with a scale of corresponding specific gravities.

**Chemicals.**—If the sensitive paper is purchased ready prepared, the only chemicals necessary will be ferrocyanide of potassium or yellow prussiate of potash, which should be of good quality, and some sulphuric or hydrochloric acid. Some oxalate of potash will be necessary for removing blue stains from the prints, and caustic potash will be found useful for removing stains from the fingers and for cleaning the zinc trays.

For preparing the sensitive paper, the following additional chemicals will be necessary:—Gum arabic, which should be of good quality, white and readily soluble; tartaric acid, or ammonio citrate of iron, according to the formula employed, and perchloride of iron. The latter salt is commonly sold in amorphous semi-crystalline lumps, but very readily diliquesces into a syrupy fluid, and therefore it may be more convenient to mix its solution to a certain strength by aid of the hydrometer.

A solution of perchloride of iron at 45° Baumé contains about 47 per cent. of the anhydrous salt, and its specific gravity at a temperature of 60° F. will be about 1.453.

**Ready Sensitised Paper.**—Paper specially prepared for this process by various continental firms is now an article of commerce easily obtainable in London or Paris. Some of Pellet's paper obtained some years ago from Mr. G. E. Chapman of 113, Victoria Street, Westminster, who also supplies all necessary apparatus and materials for the process, has lately been used in the Photographic Office, Calcutta, and found to be in good order. In many cases it might be more convenient to purchase the paper ready for use than to prepare it. Without proper appliances it is difficult to get an even coating.

**Preparation of the Sensitised Paper.**—Two methods have been tried in the Survey of India Photographic Office, Calcutta, both of which have been found to answer well.

**Paper.**—It is important that the paper used for the prints by this process should be hard and well sized, so that the sensitising solution may be kept as far as possible on its surface and stains avoided. Good ordinary drawing paper is suitable, also the Rives or Saxe paper generally used for photographic prints. The thick photographic paper No. 50, specially prepared for this purpose by Messrs. Schleicher and Schull, and obtainable from



Messrs Treacher & Co., Bombay, has been found to give the best results. Bank post paper, either thick or thin, is not so suitable.

*The Sensitising Solution. First Method.*—(a).—The following two solutions are made up separately:—

	1		
Gum arabic (best)	...	...	170 parts.
Distilled water	...	...	650 "
	2		
Tartaric acid	...	...	40 "
Distilled water	...	...	150 "

When the gum arabic is perfectly dissolved, which is facilitated by first powdering it, filter the solution (or strain through muslin) into a clean vessel. Then add, constantly stirring, the tartaric acid solution. When they are thoroughly mixed, 100 to 120 parts of a solution of perchloride of iron at 45° Baumé (sp. g. 1.453) are added in the same way, very slowly and with constant stirring, after which the mixture should be set aside in a dark place for 24 hours. Distilled water is then added until the mixture shows a density of not more than 1.100 on the hydrometer. It is essential that the mixture of the different solutions be made in the order given above. If the perchloride of iron were poured direct into the gum solution, the latter would be immediately coagulated or thrown down in a sticky, insoluble mass, which can only be brought back to a liquid state by adding an excess of tartaric acid solution; but when this latter is already present in the gum solution, there is no fear of coagulation. The solution is of an orange yellow. If kept carefully protected from light, it will keep good for a long time.

*Second Method.*—(b).—Another sensitising solution, recommended by Captain Pizzighelli, of the Austrian Army, which has been found to give brighter prints than (a), is made in the following way:—

Three solutions are made up of—

	1.		
Gum arabic	...	...	20 parts.
Water	...	...	100 "
	2.		
Ammonio-citrate of iron	...	...	50 "
Water	...	...	100 "
	3.		
Perchloride of iron	...	...	50 "
Water	...	...	100 "

No. 1 can only be kept a few days; Nos. 2 and 3 keep for several weeks in well-stoppered bottles. When required for use they are mixed together in the proportions of 20 parts of No. 1, 8 parts of No. 2 and 5 parts of No. 3, and in the order given, or the gum will be coagulated. Should this occur after all, the mixture may again be rendered liquid by adding a few drops of glacial acetic acid. In any case, the mixture of Nos. 1 and 2 thickens on the addition of No. 3 and in a short time loses its glutinous properties, and after standing a few hours becomes a thick magma: it is then, according to Pizzighelli, at its best. It has been found, however, difficult to coat the paper with the mixture in this condition, and it is better to add a little acetic acid before adding No. 3, in order to prevent the mixture from thickening. The solution will not keep more than a few days.

Whichever of these two sensitizing solutions is employed, the subsequent processes are the same.

*Sensitising the Paper.*—This operation and all the subsequent ones, except the exposure to sunlight, must be performed in a room illuminated by yellow light passing through one or two thicknesses of yellow paper or calico fastened over the windows, or by candle or weak lamp light.

The paper is laid smoothly down on a drawing board or glass plate, and must be firmly fastened down on two sides with pins, rods or clips. It is of importance to note that the sticky nature of the sensitising solution is liable to cause a dragging of the paper from its fastenings which, if not firm, may cause the paper to crease or tear.

The sensitising solution is now poured into a flat dish or plate and applied to the paper with a soft broad brush, as described above, or with a piece of soft sponge, in an even coat, passing it lightly over the paper, up and down and across, taking care to equalise the coating as much as possible and to avoid streaks. The coating should not be too thick nor yet too thin. Each piece of paper coated should be hung up at once to dry in a dark place, preferably in a drying-box heated by a stove. It is important that the paper should dry quickly, so that the solution may not sink into its substance. The paper is said to keep indefinitely, provided it be protected from damp and light. As soon as the papers are dry, it will be well to put them away carefully in an air-tight tin case. It has been found in the Photographic Office that the paper prepared by the 1st method will keep in good order, but that prepared by the 2nd method will not keep more than a day or two and therefore must be freshly prepared as required.

*Printing, or Exposure to Light.*—The glass of the pressure frame being thoroughly clean and bright on both sides, close the yellow windows of the dark-room and lay the tracing face downwards in the frame, and over it a sheet of the sensitised paper with the prepared or yellow side in contact with the back of the tracing. Over the paper lay a sheet of felt or some sheets of clean paper, which should have been previously dried in the sun, and with both hands carefully smooth outwards from the centre. Then put in the back-board of the frame and fasten down the centre bar, having laid the test slips in position, after which fasten down the end bars. Unless the plate glass, the tracing, and the sensitised paper are in close and uniform contact all over, it will be impossible to obtain sharpness in the finished prints.

If a tracing on paper is creased and wavy, it is recommended to fix it on the glass plate by gumming the edges to the glass at intervals. The back of the paper is damped with a sponge, and instantly swells out in waves, but afterwards stretches perfectly smooth on drying. In this way the smoothing is done once for all, and perfect sharpness all over the proof is secured.

The frame should be exposed towards the south, so that the sunlight may fall *perpendicularly* upon it, or so that it may get a good direct light. Care should be taken that no shadows or bright reflections fall upon it.

The sensitised paper must be kept smooth and free from creases, which would prevent perfect contact with the tracing. In damp weather special precautions must be taken to prevent the sensitive paper being affected by moisture during the operations.

The exposure varies according to the intensity of the light. In direct sunlight an exposure of 15 to 40 seconds is sufficient to produce the reduction of the iron salts to the state of ferrous chloride, except in the parts protected by the lines, where it remains in the state of ferric chloride. In the shade or dull light the exposure may be prolonged from 1 to 5 minutes; in rain 5 to 15 minutes, and in dull, foggy weather may require 15 to 30 minutes or longer. One soon learns to guess the proper exposure under ordinary conditions of working. It is important, however, that the exposure should be exactly right, and therefore unless the exact time required is known from past experience, it is advisable to make use of the following simple test:—A few lines of varying thickness are traced on the edges of the drawing to be copied, in the same ink as was used to make the drawing. Over these lines and between the drawing and the sensitised paper are placed some slips of the same sensitive paper, about one inch wide, the ends of which protrude beyond the edges of the printing frame in such a way that each slip can be drawn out of the frame at will. It is then possible by testing the effects of light on each of these slips with the developing solution successively at different intervals, to watch the progress of exposure, which is not possible in any other way, because the paper changes color but slightly under the



influence of light, and by opening the frame there would be risk of doubling the lines.

When it is not convenient to draw the test lines on the tracing itself, they may be drawn on a small separate piece of tracing paper of the *same quality as the original tracing*, which is placed in a small pressure frame and exposed alongside the tracing being copied, and under exactly the same conditions of lighting.

To apply the test, expose the frame to full sunlight for a few seconds, then turn it over to protect the sensitive paper from light, and withdraw one of the test slips. Then immediately plunge the end of the slip which was inside the frame and under the black lines drawn on the edge of the drawing into the solution of ferrocyanide of potassium used for developing, and watch its chemical action for 40 to 50 seconds. If the lines appear at once in blue, but the ground of the paper is also tinted blue, the exposure is insufficient and must be continued. These tests are continued after intervals of a few seconds with fresh slips of test paper, until a point is reached when the paper remains yellow and quite free from blue spots, but the lines appear sharply reproduced in blue, which indicates that the exposure is exactly sufficient. If, however, the ground of the paper remains yellow, but the lines are broken and faint, the print has been over-exposed and should be rejected. The print, having been correctly exposed, is taken to the dark-room and there removed from the frame.

If the copies are rolled up, put in a dry place and excluded from the light, they may be kept for some hours or even days before being developed, and thus the printing can be completed under uniform conditions in the best part of the day.

*Development of the Prints.*—This operation must be performed in yellow light.

The developing solution consists of a solution of ferrocyanide of potassium at 20 per cent., or about saturation.

Should crystals form in the solution, water should be added to just dissolve them. The specific gravity of the solution should be about 1.1275, or about 16°B, and it should not be used to saturation in hot weather, when more of the salt will be dissolved.

The solution is conveniently prepared by putting a quantity of the yellow crystals into an enamelled pot with two or three times the quantity of boiling water, and stirring the solution from time to time with a wooden rod. The solution is poured off into the tray as required and more crystals and water added as necessary to keep up the stock.

The bath can be used till it is exhausted and is in no way dangerous.

A sufficient quantity of this solution at the strength indicated above should be poured into the first tray so as to fill it to the depth of about an inch. The print should not be allowed to touch the bottom of the tray, otherwise stains will be caused.

Before commencing to develop, the prints are laid *face downwards* on a table, and the edges turned up carefully with the aid of a straight edge, so as to form a sort of tray  $\frac{1}{4}$  inch in depth. This renders the sheet more easy of manipulation, and leaves the back white, and in the end saves time. The copy must then be floated face downwards on the prussiate bath (No. 1), care being taken not to get any of the prussiate solution on the back; any air bubbles must be removed by each of the corners of the copy being quickly lifted in turn by one hand, and gently lowered again, the other hand being used at the same time to drive out the air bubbles from the centre. After floating the copy on the prussiate bath for half a minute, the copy must be lifted by raising one end with care. This can be done without getting any of the prussiate on the back, which otherwise would leave blue stains. The copy must now be held up, and the action of the prussiate allowed to continue, but only so long as the yellow ground remains free of blue spots. The longer the copy can be kept with the film of prussiate on, the stronger and darker will the lines come out. As

soon as *blue spots begin* to appear on the yellow background, the copy must *at once* be immersed face downwards in the zinc tray (No. 2), already filled with clean water. This checks the further action of the prussiate solution. One edge of the paper must now be depressed beneath the surface of the water, and the whole paper then lifted by that edge; the water will thus be made to flow all over the back of the paper. This washing must be repeated two or three times, then the copy must be wholly immersed in the hydrochloric acid bath (No. 3) for five to fifteen minutes, and its surface dabbed all over with the brush in order to start and loosen the blue mucilage.

The copy is next taken out of the acid bath and must be laid face upwards in the *empty* zinc tray (No. 4), where it must be well rubbed all over with a brush to get rid of the superficial blue mucilage, and then copiously flushed with plenty of clean water. The lines of the copy will then be found to stand out blue on a clear white ground. The copy must be hung over a half-round piece of wood to dry. If only one zinc water tray is used for washing in after the chemical baths, care must be taken to rinse it out well after *each* washing, as the *slightest admixture of the acid and prussiate solutions would stain the copy blue*. It saves time if several copies be developed up to the acid bath stage and left, care being taken to turn each copy face downwards before another is put on the top of it; also always place the copy in the acid bath with the face upwards, then brush over with the acid solution, and turn face downwards.

*Acid Bath.*—Either sulphuric or hydrochloric acid may be used for clearing the prints. The former requires more precaution in using than the latter. It must be mixed in strong stoneware vessels by adding three parts of the acid to 100 parts of water and not *vice versa*.

The strength of the hydrochloric acid bath is from 8 to 10 parts of acid to 100 of water. A mixture of two quarts of the acid with five gallons of water will fix about 100 copies double elephant size, after which the solution becomes full of blue precipitate and should be renewed. The objection to the use of this acid is on account of its fuming, but this is slight.

*Causes of Failure.*—1. The ground appears blue. This arises from under exposure to the light, or from the print having been kept too long exposed to the action of the prussiate bath.

2. The lines are broken and pale while the ground remains white. This may be due to overexposure or to the lines of the tracing not being sufficiently opaque to stop the passage of light through them.

3. When the print is put in the acid bath, the lines turn a dark blue, which washes off when being brushed. This arises from insufficient development in the prussiate bath; if the ground is also blue spotted, it is from under exposure.

*Removal of Stains.*—If in spite of all precautions stains or spots of blue appear on the ground of the print, they may be easily removed, or alterations made in the drawing, by means of a solution of oxalate of potash made by dissolving one part of the neutral salt in four parts of water. A solution called "*Blue Solving*" is sold ready prepared for this purpose. The liquid is applied lightly with a camel's hair brush to the stains or lines to be erased, and dried off with blotting-paper. When dry the parts will appear white. This solution should only be applied to the prints when *dry*.

Blue stains on the fingers may be easily removed by means of a very weak solution of caustic potash or soda, and may be avoided by the use of India-rubber gloves or finger stalls.

Prints produced by this process are quite permanent and unchangeable by light or damp.

*Preparation of Drawings or Tracings.*—Any drawing or print in black ink on white paper not too thick can be copied by this process; but to secure the best results it is preferable to use tracings with a clear translu-



cent ground and black opaque lines carefully prepared for the purpose.

The tracing paper should be quite white or slightly blue, fresh and transparent, of even texture, and free from stains or spots. Old paper, which is generally yellow and brittle, should not be used.

The tracing or parchment papers specially prepared by Messrs. Schleicher and Schull for photographic work are to be recommended, and are obtainable from Messrs. Treacher and Co., Bombay.

The drawing must be made with perfectly black ink, in firm full lines, especially the finer ones, so that they may be quite opaque. Some Indian yellow or burnt sienna may be added to the Indian ink to give it additional opacity. Care must be taken to keep the back of the tracing clean and free from anything which might print through and interfere with the clearness of the design.

As far as possible, all lines usually drawn in color should be drawn in black dotted lines of different kinds. However, if the use of color in the original is compulsory, red lines should be drawn in thick vermilion or burnt sienna; yellow lines with Indian yellow or chrome yellow; brown with burnt umber, sepia, &c.; blue and green lines with a mixture of chrome yellow and dark prussian blue in different proportions. Pale blue lines, for water levels, &c., will not reproduce, and should be drawn in black.

All washes of color should be avoided on the tracings. They can be put on after making the reproductions, and may in many cases be replaced by ruling or cross-hatching.

Tracing paper is recommended in preference to tracing cloth as more even in texture and allowing of finer lines being drawn on it.

#### MINING IN GREAT BRITAIN.

(From our own Correspondent.)

A MODIFICATION of Liveing's apparatus for the detection of explosive gases in mines is being applied to electrical mining lamps. It consists of a pair of short glass cylinders, fitted with platinum wires. The ends of one cylinder are closely sealed, and the ends of the other are protected with discs of wire gauze. These cylinders are attached to the sides of the electrical lamp, and suitable switches are provided, so that the current of electricity may be transmitted from the battery through both of the wires. If no gas or firedamp be present, both of the wires will be equally luminous; and if gas be present, the platinum wire enclosed in the gauze cylinder will be most luminous. The estimation of the percentage of the firedamp present must be made by the eye, as the scale which is usually attached to M. Liveing's apparatus is omitted in this modification.

Mr. Preece, in a lecture at a recent meeting of the Royal Institution of Great Britain, said that electric mining lamps are simple of construction, easy of inspection, and are not likely to be extinguished in handling like the Mueseler; but they do not act as detectors of the presence of gas, and they might explode gas if their protecting glass shield were accidentally broken. Mr. Liveing's valuable invention will discover the presence of firedamp, it therefore remains for other inventors to devise means for detecting the presence of carbonic acid gas, and of preventing the ignition of gas should the lamp be broken or damaged.

The question of Canal *versus* Railway is receiving considerable attention in the midland counties. A scheme has been recently suggested for the formation of a national canal as a main route between the Thames and the Mersey, and branches to the Trent and Severn. There is certainly need for the present scheme, by which the economical transport of merchandise and new materials could be secured. The promoters have appealed to the Government, and ask that the State should acquire the existing canals, with the view of their use free of all tolls. If turnpike roads can become free of tolls, there appears to be no valid reason against traffic upon canals being similarly freed. If transport were so lightened, it must in the end conduce to the benefit of all classes.

A blower of firedamp is being successfully employed to fire a Lancashire boiler at Hebburn Colliery. The gas is piped for some distance underground to the boiler on the

surface. The furnace end of the boiler tubes is closed in with the exception of a small rectangular box for the admission of the air. The gas is burnt from the end of a common pipe and passes round a circular bridge placed about five feet from the furnace end of the boiler. A volume of about 140 cubic feet of the firedamp is said to produce the same volume and pressure of steam as the combustion of 5 tons of coal daily. Arrangements are being made for the application of the gas to other boilers.

A water spray is used at the Dowlais Collieries in connection with compressed air for cooling the ventilating current and damping the coal dust. The water is collected in a cistern in the shaft, and issues with a pressure of 90 pounds, and the air at 45 pounds is drawn from the supply to an air hauling engine. The air is introduced by a jet into the centre of the stream of water, and a very fine spray is produced, which is carried for some distance in suspension in the air current. The managers of the colliery may be congratulated on the success that has crowned their efforts.

The want of some means of communication between men in the cage whilst ascending or descending the shaft has been successfully supplied by the invention of Mr. William Armstrong of Wingate Colliery. It consists of the insertion of an insulated copper wire in the central core of the wire rope. This copper wire is then used for the transmission of signals or other communications by means of electric or telephonic appliances. The invention is most useful, more especially when applied to the examination of the shaft, guides or conductors, where the cage is required to be stopped and reversed at frequent intervals, in order that the men may make the necessary inspection.

#### NOTES FROM HOME.

(From our own Correspondent.)

ACCORDING to the Patent Office Report for 1887 the total number of applications for patents during that year was 18,051, as compared with 17,176 for the preceding year; of these latter 53 per cent. have been proceeded with. The corresponding figures for designs are 25,734 and 23,717 respectively. Of the patents 76 per cent. came from residents in the United Kingdom. The gross receipts on account of fees for patents, designs and trade marks, and sale of publications amount to £124,279.

Mr. Norman Shaw, the Architect, has lately published a description of a new form of drain pipe which he is now using instead of the ordinary socket jointed tubular pipes. It consists of a culvert made of glazed earthenware of egg-shaped section, open all along the top with a rebated flange to receive a cover. After these semi-pipes are laid and jointed with cement they can be inspected from end to end, each joint can be examined to see if perfect, whilst the uniformity of the fall can be easily tested, and if necessary, corrected with facility. When this has been done the tile covers are put on pointed with cement, and the whole floated over with the same material. Experience will alone prove whether this novel form of drain pipe possesses the advantages claimed for it by its designer.

Both technical and commercial papers are unanimous in confirming the opinion of the House of Commons in its rejection of the Channel Tunnel Experimental Works Bill. The commercial aspects of the scheme being doubtful, as it is pointed out that even if the whole Continental passenger traffic could be carried through the tunnel, it would scarcely pay a fractional dividend on the immense sum required for the construction of the works, and further, there is a limit to the carrying capacity of a double line of rails in a tunnel of such a length, which must necessarily be worked on the block system. And now that the Bill has been so decidedly rejected by Parliament, the Government is urged to take strong measures, by destroying the works which are now under construction within the three-mile limit, and so finally settle the question.

The great Railway Companies owning the lines between London and Scotland have this month further accelerated their express trains. On the Great Northern Railway the "Flying Scotchman," which has performed the journey heretofore between London and Edinburgh in nine hours, is now timed to do the distance in eight and a half hours, and the first train from King's Cross arrived in Edinburgh four minutes before time. The distance between London and Edinburgh being 397 miles, this gives a running speed of



nearly 47 miles an hour including stoppages. The Midland Railway Company now run between Glasgow and St. Pancras in nine hours and 20 minutes, being a saving of 65 minutes on their former time; whilst the distance between Edinburgh and London by this route is done in nine hours and 50 minutes, being a saving of 20 minutes on the time previously allowed. Considering the heavy gradients that the Midland Railway has to work over and the longer distance travelled, this must be considered a fine piece of engine performance. The North-Western Railway also have made important accelerations of speed on their through fast trains. It is interesting to note that these fine express trains are worked by totally different types of engines. The Great Northern Company adopt bogie outside cylinder 8 feet single engines; the Midland with their heavier gradients use bogie coupled engines, whilst Mr. Webb, on the North-Western, uses his three-cylinder compound engine.

The veteran Sanitarian, Mr. Edwin Chadwick, C.B., is to preside at the twelfth anniversary meeting of the Sanitary Institute of Great Britain, which is to be held at the Royal Institution, Albermarle Street, on the 12th instant. At this meeting Dr. B. W. Richardson is to read an address on the "Storage of life as a sanitary study."

The *Engineer* gives a drawing of the engines of the *Re Umberto*, the Italian war-ship now being built at Castelmare. The drawing is a copy from one of the largest photographs of steam machinery ever taken. These engines indicate 10,000 horse-power on each screw. The *Re Umberto* is intended to steam 18 knots, and she will carry four 110-ton guns *en barbette*.

From Paris we read that a good deal of work is going on now in the gardens in connection with the Exhibition. The Eiffel Tower has already progressed as far as the floor of the second story. It is intended to utilize the Tower for the fireworks display at the Fete Nationale, and on the same day nearly 3,000 Mayors are to be entertained at an immense banquet.

The fears entertained in the early part of the year as to the great deficiency in the water-supply for the large towns, have been quieted to some considerable extent by the excessive fall of rain during the past and present month. The fear at Liverpool, where the daily supply has been so restricted in order to economize the quantity of water stored in the reservoirs, has been allayed by the storage of over 60 million gallons of water during the past week, and a similar result has been reported from other large centres of populations throughout the country.

## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

#### Bombay, July 29, 1888.

His Excellency the Governor in Council is pleased to appoint Rao Saheb Nilkunt Govind, Sub-Engineer, 3rd grade, to be an Honorary Assistant Engineer, 3rd grade, to complete the establishment.

Mr. R. Barnes, Assistant Engineer, 2nd grade, has passed the Departmental Examination prescribed in the Public Works Code.

#### N.-W. P. and Oudh, July 28, 1888.

##### *Buildings and Roads Branch.*

The rank of Honorary Assistant Engineer is conferred on Mr. G. W. K. Martin, Sub-Engineer, 2nd grade, with effect from the 11th July 1888, *vice* Mr. S. Peart, deceased.

##### *Irrigation Branch.*

His Honor the Lieutenant-Governor, North-Western Provinces, and Chief Commissioner, Oudh, is pleased to order the following promotions, with effect from the dates specified:—

Mr. W. B. Gordon, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Mr. Francken, granted furlough, with effect from 7th July 1888.

Mr. M. Nethersole, from Assistant Engineer 1st grade, to Executive Engineer, 4th grade, temporary rank, *Vice* Mr. Mackenzie, granted furlough, with effect from 7th July, 1888.

Mr. H. J. Strickland, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Mr. A. Grant, granted furlough, with effect from 8th July 1888.

### India, July 28, 1888.

Mr. C. H. Wollaston, Assistant Engineer, 3rd grade, Burma, is promoted to Assistant Engineer, 2nd grade, with effect from the 26th May 1888.

Mr. E. W. Arundell, Deputy Consulting Engineer to the Government of India for Railways, Central Division, is appointed to officiate as Consulting Engineer to the Government of India for Railways, Central Division, during the absence on privilege leave of Mr. R. T. Mallet, or until further orders.

Mr. A. C. Cregeen, Superintending Engineer, 1st class, State Railways, is permitted to retire from the service, with effect from the afternoon of the 4th February 1888, the date of the expiration of his furlough. This cancels Public Works Department Notification of 15th March 1888.

#### *Military Works Department.*

The undermentioned officers are appointed to the Military Works Department as Assistant Engineers, 2nd grade, temporary rank, with effect from the dates specified:—

Lieutenant E. H. DeV. Atkinson, R.E.,—9th January, 1888.

Lieutenant G. A. Travers, R.E.,—27th January 1888.

Lieutenant W. V. Scudamore, R.E.,—27th January, 1888.

Lieutenant R.E. Tomlin, R.E.,—1st February 1888.

Lieutenant G. P. Lennox-Conyngham, R.E.,—14th February 1888.

Lieutenant A. J. H. Swiney, R.E.,—24th February 1888.

Lieutenant J. H. S. Murray, R.E.,—7th April 1888.

### Punjab, July 26, 1888.

#### *Irrigation Branch.*

Mr. R. W. Rowland, Assistant Engineer, 1st grade, from the Patiala Division, Sirhind Canal, to the Ferozepore Division, Sirhind Canal, which he joined on the forenoon of the 24th June 1888, on return from the one month's privilege leave granted him in Irrigation Branch Memo, dated 4th June 1888.

### Madras, July 24, 1888.

Mr. J. Inglis, Assistant Engineer, 1st grade, is granted furlough on medical certificate to 29th July 1888, in extension of the leave granted to him in Notification published in the *Fort St. George Gazette* of the 19th June 1888.

### Burma, July 21, 1888.

Mr. J. P. Henderson, Assistant Engineer, 1st grade, Meiktila Division, is granted one year's furlough to Europe, with the usual subsidiary leave, from the forenoon of the 28th June 1888. This cancels Upper Burma Public Works Department Notification dated the 20th June 1888.

With reference to Upper Burma Public Works Department Notification dated the 19th May 1888, Mr. B. Baxter, Executive Engineer, 2nd grade, took over charge of the Ruby Mines Division on the 20th June 1888.

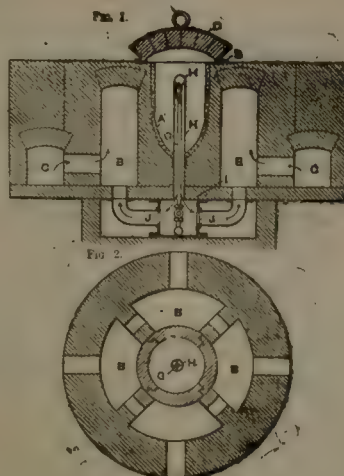
### Bengal, August 1, 1888.

Rai Annoda Prosad Sarkar Sahib, Assistant Engineer, is transferred from the Brahmini-Byturni to the Acquapada-Jajepore Division.

## Indian Engineering Patent Register.

### RECENT BRITISH PATENTS.

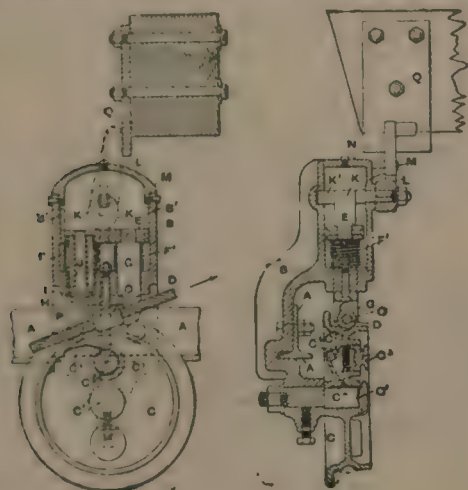
CASTING METALS.—*B. H. Thwait, Liverpool.*—The essential feature of this invention is the cooling of the metal from the centre to the outside. The object of this reversal of the usual order is to allow the enclosed gases to escape from the inside of the metal. Previously to pouring the metal into the mould, a cooling tube is placed exactly in its centre, and in such a position that the absorption of heat from the mass is uniform. The cooling tube is placed inside another of





slightly greater diameter, the latter tube serving for the escape of the cooling fluid. The application of this method to the casting of projectiles is illustrated in the accompanying figures. The mould A is surrounded by a gas combustion flue B, which is supplied with fuel from the flue C, and over the mould is placed a cover D which rests on a recess E. The inner pipe G supplies the cooling medium, which consists of either refrigerated air, oil, steam, or water; and the annular space between the pipes G and H allows the return of the fluid. If air is the refrigerating medium, it is afterwards utilised to support the combustion of the gaseous fuel, and for that purpose it is led through the connecting flues J into the flue B. The cooling pipe H is made of the same quality of steel as is used for the projectile, and is fixed in a central orifice I by means of a screw thread. The hollow which is left in the projectile in consequence of the hollow tube H is afterwards filled up with a fine steel plug and cap. If, however, it is desired that the cooling pipe H shall not form part of the projectile, the pipe H may be surrounded with some woody fibre, which will become charred when the metal is poured into the mould; the same object may be also attained by making the pipe of silicious or other refractory material. Four claims are made.—No. 6058. April 26th, 1887.

**TIEPHERAGE.**—H. H. Lake, London (T. Otto, Schkenditz, Germany).—Improvements are here introduced into the method of coupling the trucks to the hauling ropes of wire ways or elevated railways. The claw grip illustrated in the accompanying figure may be advantageously used on steep gradients. A is the cross bar of the suspension frame for the buckets, and B is a casting which is firmly attached to the cross bar; the roller C is supported on a spindle C<sup>1</sup> and acts as a guide for the hauling rope D when the bucket is uncoupled from the rope. For the purposes of lubricating the spindle, a recess C<sup>2</sup> is formed in the wheel; the oil is held in its place by the screwed plug C<sup>3</sup>, which is prevented from shaking loose by means of the ratchet teeth C<sup>4</sup> and the spring C<sup>5</sup>. The cross head E is supported by the springs F F', and may be moved vertically in the guides B; to the lower



side of the cross head is attached a forked gripper G and a sleeve H; the sleeve also carries another gripper I, which is constantly pressed against an inwardly projecting flange on the lower end of the sleeve by means of a spring J. An eccentric K is attached to a spindle K<sup>1</sup>, and has a projecting extremity upon which is fixed an arm L. In coupling a truck to the rope, the latter is first placed upon the roller C, and then the cross head E is lowered by turning the lever L; the grippers G and I are thus caused to engage with the rope. The travel of the lever is limited by the stop M. When one of the carrier collars O, which are placed at various points along the rope, approaches the gripping apparatus, while the rope is in motion, the collar presses against the inclined surface P of the gripper I, thus lifting the gripper and striking against the other gripper G. As soon as the collar has passed the first gripper I, the latter is forced down by the spring J and the coupling operation is complete. In order to stop the buckets at any point of the line, it is necessary to release the grippers G and I; the lever L strikes against the fixed plate Q, which is placed in the position where it is desired that the buckets shall be released, and is forced back; the eccentric K is turned, whereupon the springs F F' raise the cross head E and with it the grippers G and I to a sufficient height to allow the hauling rope and the carrier collar to pass freely between the grippers and the roller C. Seven claims are made for the coupling device, for the construction of the collar and for an arrangement of the truck frame.—No 7507. May 23rd, 1887.

## Advertisements.

### WANTED

**T**WO Assistant Local Fund Engineers on salaries of Rs. 200 and Rs. 150, with travelling allowance of Rs. 3 and 2 respectively for the Salem District Board. Applications with testimonials should be made before the 10th August 1888 to the PRESIDENT, DISTRICT BOARD, Salem.

## East Indian Railway.

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**A** DRAFTSMAN and SURVEYOR, salary, Rs 75. Apply, with copies of testimonials (which will not be returned), to the District Engineer, E. I. Railway, Dinapore.

D. W. CAMPBELL,

Agent.

CALCUTTA, 30th July 1888.

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**A** Permanent DRAFTSMAN, Salary Rs. 40, rising to 60 per month.

He must be competent to take out quantities and check measurements of Estimates from the drawings. Knowledge of English is necessary.

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H. H. COLE, MAJOR, R.F.,  
Executive Engineer, Bareilly Division,  
MILITARY WORKS.

## BURMAH P. W. D.

**W**ANTED—For the Office of the Superintendenting Engineer, 2nd Circle, Thayetmyo, a duly qualified Estimator, Salary, Rs. 100 a month, rising to Rs. 120. One who is also a qualified draughtsman preferred.

Apply, by letter only to

The Personal Assistant

SUPERINTENDING ENGINEER,

2nd Circle, Thayetmyo.

*Note.*—Copies only of certificates should be sent, as no enclosures will be returned. (136)

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25,000 maunds of first-class fresh Sylhet lime for the new Offices at Fairy Hill. The lime must be delivered unslaked sufficient to give the above quantity when slaked.	Nr.	14 M.	As per rates printed on the back of form No. 14 M.	20th August 1888 (noon).	1st October 1888 with an average monthly delivery of 2,000 maunds.	1st October 1889.	Rs. 10 per cent. on the total value.	The rate is to include slaking and the delivery of the lime at site of work on top of Fairy Hill at Chittagong. Another rate is also to be given if delivery is taken slaked in the store shed by the River Bank at Sudder-ghat, Chittagong. 100 maunds of slaked lime is to be taken as 225 c. ft. measured by tape.

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The 27th July 1888.

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WANTED.

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EDWARDESABAD,

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(166)

NOTICE.

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The vessel is laying off the Salt Golah Moorings, Howrah.

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EATON W. PETLEY,

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CALCUTTA PORT OFFICE ;  
The 21st July 1888.

(167)

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(168)

Telegraphic Address—"SILVERGRAY," CALCUTTA.

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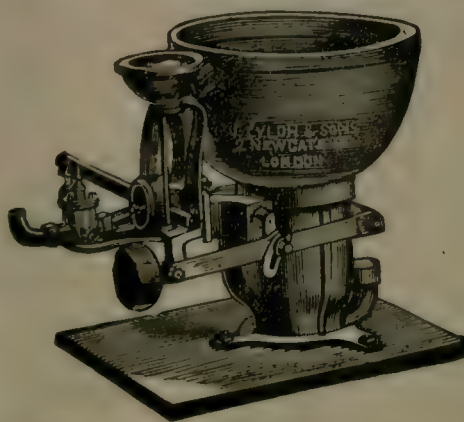
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NOW READY.

"Artesian Borings in the Sunderbunds."

As the issues of the journal containing the articles headed as above are out of print, and sufficient inducement having offered, the matter has been reproduced in pamphlet form to meet the requirements of District Officers and others in Bengal and elsewhere.

Price Rs. 2 per copy.—Cash.

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INDIAN ENGINEERING.

SATURDAY, AUGUST 11, 1888.

THE HOOGHLY "JUBILEE" BRIDGE.

REFERRING to the concluding part of the article on the Hooghly Bridge discussion in our issue of 9th June, the London Engineer remarks : "Considering the small distance between the steel cylinders, the amount of the total expansion in that length and the exceedingly small amount by which it will be impeded and the difference in the co-efficient of expansion of the rod and of the girder, it can hardly be expected that there would be much to translate into the strain on the latter."

Now, we are quite open to correction, but in this case it appears that our contemporary has not taken the trouble to read the discussion on the Bridge before replying, or he would have seen that the theoretical expansion between the piers to which the cantilever is bolted is 0.9", equivalent to a strain of 8½ tons per square inch; while it is supposed that on account of the bottom chord being to a certain extent sheltered from the sun's rays, the actual difference will not be more than 0.6", equivalent to 5½ tons, an amount quite worth taking into consideration.

As for "the exceedingly small amount by which it will be impeded," we cannot agree that this describes the resistance of the massive and short piers to a horizontal thrust.

Nor do we see why the co-efficient of expansion of the rod and girder should be different, if both are made of steel, nor indeed, what it has to do with the result. We gave our readers credit for sufficient intelligence to perceive that the same metal should be used, or a correction applied for any difference in expansibility.

There may be no strain worth reckoning, but it was precisely because it is a case that cannot be settled *a priori* that we suggested an actual measurement which could easily be made, and of which the results would be most interesting.

We will improve on our original suggestion, by letting the free end of the rod bear on a very small steel roller between it and the girder, with a light index at the end of the roller, so that the slightest difference in expansion between the rod and girder would give considerable angular defection, in the same way as a Shomeyer's strain indicator.

INDIAN RAILWAYS.

WE are always glad to record the financial success of the Railway system in this country, but referring to the published minutes of the half-yearly meetings of the shareholders in the several Railway companies, we confess to a feeling of disappointment at the general results obtained throughout India. Various causes have been at work to produce this undesirable state of affairs which will be discussed under each notice separately; it should, however, be borne in mind that India is more of a continent than a country, and a combination of favorable



circumstances cannot be uniformly expected. At the same time it must be observed that this temporary adverse turn affairs have taken is due as much to natural causes as to keen competition among the different 'lines,' which has contributed in no small degree to the benefit of the public:—

DURING THE HALF YEAR ENDING DECEMBER 1887.

*Madras Railway.*—There was a decrease of £4,500 in the gross revenue, and an increase in expenditure of about £15,000, making a total of diminution in the net revenue of nearly £19,500. Among the causes which have been in operation during the period under review are the following:—The open mileage was 30 miles less than in the corresponding half of last year. The Calicut and Palghat extensions were not opened for traffic until 2nd January of the current half-year. Although the receipts per mile were £10 more, the number of train miles run was rather less, and the receipts and expenses per train mile were not so favorable. The average receipt per train mile was almost exactly the same—viz., 3.44 against 3.45. The decrease in the coaching traffic amounted to £8,859, and £2,350 is due to the temporary falling off in receipts from passengers. The most singular phenomenon in connection with the passenger traffic is that notwithstanding the increase by 84,000 of third-class passengers, the earnings fell by £2,000, owing no doubt to the shorter distances travelled. The goods traffic has risen from 511,000 tons and 34 lakhs of rupees in 1883 to 688,000 tons and 41 lakhs in 1887, and as compared with 1886 alone the goods traffic was larger in 1887 by 48,000 tons in weight, and one lakh in money.

*Oudh and Rohilkund Railway.*—The Chairman, in opening proceedings gave a *résumé* of the work of the Company during the last 21 years. The line would by purchase pass into the hands of Government by December 1888, for which purpose an Act had been passed to enable the Secretary of State to raise £7,000,000. The gross earnings of the current half-year up to 5th May 1888 exceed those for the same period of 1887 by £24,120, and there was no doubt that for the six months to the 30th June the 5 per cent. guaranteed interest will not only be earned, but exceeded. The fact is that during the twenty-one years the Company has been in existence, there has been a heavy drain on the revenue, which has always had to carry the burden of heavy unproductive capital—for example the Dufferin Bridge—perhaps the finest Engineering work that has been created in the world. Besides this there have been necessary extensions and bridge connections which have entailed heavy expenditure, which, if not undertaken at the last moment before the Government expressed its intention of taking over the line, the Company would not only have been in a position to pay 5 per cent., but the shares in the market would have occupied a much better position at the present time than they did. A representation had been made to Government to permit the present management to continue, but up to the date of the meeting it had been received to the proposal.

*Great Indian Peninsula Railway.*—Colonel James Holland, Chairman, initiated the proceedings of the day with serio-comic remarks on the prospects of the Company. He observed that after announcing years of profit which this line had earned, it was something like a cold *douche* to be told that a slight falling off would have to be met, an incident quite beyond control. Besides, there being a general deficiency in the whole of the trade of India during the past year, the principal staple commodities, cotton and linseed, had both been failing crops, either from abundant rain or too little, in the beginning. Then in regard to wheat alone, the deficiency in the quantity carried was much greater than sufficient to account for the entire deficit: this would have been still larger, but for the fact, that the Company had to carry a larger quantity of Railway material for the Railways running to the north-east and south-east, but as this sort of traffic could not be expected to continue long, the objects for which those Railways were constructed would of themselves far more than make good before long for any temporary deficiency. The working expenses were pretty large; the loss by exchange was £1,330, the expenditure on renewal of permanent way was £4,900, greater during the past half-year than it was in the corresponding period of the previous year. The net earnings in 1883 were £425,000, for December half-year; in 1884, £427,900; in 1885, £566,000; in 1886, £715,000; and in 1887, the present half-year, £585,000. In 1878, 4,377,000 passengers were carried; last year, 8,533,000 passengers were carried. In regard to goods traffic, in the second half 1877, 803,000 tons were carried: in the corresponding period of 1887, 1,141,000 tons were carried.

*Indian Midland Railway.*—Great progress has been made in this line; it is a record of hard, honest, indefatigable work, especially since the line from Cawnpore to Jhansi has been opened. Better results will be shewn when it is connected with the Great Indian Peninsula Railway at Itarsi and Jhansi, and that will be at no distant date. The following paragraph, taken from a Bombay paper, will prove the utility of this line:—

A considerable section of the Indian Midland Railway was on Wednesday thrown open to public traffic. Some three years ago we were able to make the gratifying announcement that the Secretary of State had sanctioned the formation of a company to construct a line which will provide the shortest practicable route between the richest wheat-producing districts of India—those of the South-West Provinces—and the markets of Europe. The importance of this as a factor in the welfare of the empire could not be over-stated, when the large area under wheat cultivation, the enormous proportions to which the trade in wheat has grown, and the competition with other countries to which it is subjected are considered \* \* \* \* \*

The rapidity with which the works have been carried through has not, we believe, been surpassed, if equalled, in the history of Railway construction of the character of this line; while the cost at which it will have been constructed and equipped will not, the Directors anticipate,



exceed the estimate of £8,000 a mile; the interest on which, as affecting the amount of net earnings necessary to make the line remunerative, is of great importance, and must materially influence the powers of the Company in competitive rates, even to the extent possible of counteracting the disadvantage under which it labors from its insular position in respect to English coal, and its distance from Indian mines, in regard to the cost of native coal for its locomotives.

#### THE NEW FACTORY ACT.

COMMERCIAL circles in Bombay are being exercised about a proposed new Factory Act, necessitated mainly it would seem by regard for the health and well-being of juveniles employed in the local mills and manufactories. Children seven years old have to work in their close steamy atmospheres for nine hours a day, even in the hottest of hot weather. This is penny-wise-and-pound-foolish policy, to say nothing worse of it. Nature revolts against the strain of excessive work, and children—or men either for that matter—are physically incapable of turning out good work, turning out anything but scamped unprofitable work, after strength has been exhausted, and intelligence dulled, and digestion impaired, by unduly long spells of toil in a hot, vitiated atmosphere. Nine hours is too much for children, especially in an Indian climate. Then, again, the child is legally held to become an adult when twelve years old; he or she is then a full-time worker; and there is nothing in the law to prevent their noses being kept down to the grindstone thirteen hours a day, or even longer. The law takes no more care of him. The Factory Act, says the *Bombay Gazette*, has the usual regulations for the fencing in of machinery, and dangerous gear; and there it stops. Decidedly it ought not to be allowed to. If Bombay mill-owners are so short-sighted, so blind to their own interests as not to be able to see that it does not pay to overdrive even a willing horse, much less to use whip and spur in efforts to get a gallop out of a tired one, why they must be treated as incapables, and their conduct put under regulation accordingly. In 1884 a Commission was appointed to enquire into the working of the Indian Factory Act of 1881. It held some thirty sittings, its enquiries and deliberations extended over six months, and in its Report unanimous expression was given to an opinion that immediate legislation was called for, the existent Factory Act being inadequate, inefficient, and affording practically no protection to the classes for whose benefit it was intentioned. The Government of Bombay fully endorsed the conclusions, and backed up the recommendations of this Commission. Differences of opinion between the local and Imperial Governments, and opposition on the part of sundry mill-owners, blocked the way to reform however; and with regard to an equitable satisfactorily working Factory Act, Bombay is no better off to-day than it was before the Commission sat.

The duty of inspecting mills and factories has, it appears, been attached to the office of the Assistant Collector of Bombay an official whose experience has, in

the course of years, lain in many diverse directions, but never in the direction of such overlooking and overhauling as he is now called upon to undertake. We are told however, of one respect in which progress has been made since the Commission's Report in 1885. Most of the larger establishments have accepted its provisions, and are carrying them out honestly, if not enthusiastically. The Commissioner found that the factories most in need of attention now were the smaller establishments which, employing less than 100 hands, did not come under the Act of 1881, and were in fact under no regulations at all. Certain sections of the new Municipal Bill, however, deal with these in such a manner that there will be no need to make provision for them in the new Factory Act. They are, for the most part, strictly sanitary in their object, one of the most valuable amongst them being that by which the Municipal Commissioner is empowered to call upon the owner of an ill-ventilated, unclean, overcrowded, or dangerous workshop or factory, to put it in order. The Commission reported strongly on the necessity for embodying in the new Act the sanitary provisions insisted on by English law. Better ventilation is much needed. The *Bombay Gazette* tells a story of a mill-agent more concerned about the health of his highly paid manager than about that of his mill operatives. His advice to the former was not to go into the mill oftener than he could help, as if he did he would surely fall sick. At least ten per cent. of the operatives do every weather, owing to defective ventilation, soddened air, damp floors, &c. All these nuisances are remediable and ought to be remedied, and if this cannot be managed without legislation, legislation let us have. The sooner the better. The contemporary, from whose columns we have already quoted, writes:—"The mill-owners themselves would benefit by an alteration in the law in precisely the measure that every employer profits by an increase in the efficiency of the labor he employs. It goes without saying that mill-hands working in a vitiated atmosphere for thirteen hours a day, are not efficient instruments. As to the hours of labor, it was little enough that the Commission asked. They named nine as the minimum age at which children should be permitted to work, and proposed that fourteen years, instead of twelve, should be the age at which an operative should be deemed an adult, and his labor no longer subject to regulation." What have the twelve-year-old adults to say on the subject.

And, after all said and done, has any legislation whatsoever much power to alter relations between labor and capital that grow up out of surrounding circumstances, and are much more likely as a rule to adjust themselves amicably and equitably if allowed to find their own level than they are when legislated and milksopped for. It seems to us that there is sometimes a tendency now-a-days on the part of Government to meddle with the course of trade more than is needful. We do not say that this has happened in the case of the Bombay mills; but assuredly the tendency needs looking after, and on occasion holding in check by our Chambers of Commerce and Trades Associations.



## ENGLAND AND RUSSIA IN CENTRAL ASIA.

MR. STEAD, of *Pall Mall Gazette* notoriety, is nothing if not sensational; and all his ducks are swans. General Annenkoff is one of the latest additions to the flock. He is referred to as a Russian de Lesseps, a Napoleon of Railway construction, a terrestrial providence rising very superior to all the forces of Nature. *Aprpos* of his mastery over events, he told Mr. Stead:—"When I fix a day for opening a line, it is opened on that day, come rain, or come storm." He also told the *Pall Mall* man that he made his trains run faster than any others in the Russian Empire. "Wherever I go, I quicken the pace," he boasted. The length of Central Asian Railway just opened to Samarkand, General Annenkoff claims to have constructed for half the sum estimated by Engineers, as indispensable. "Labor is very cheap in those regions" he explains. Which, being interpreted into the vulgar tongue, means probably that *begar* labor is cheap—or seems so from a mere disbursement point of view. A point of view not always or necessarily, or frequently even, the most really economical in the long run.

General Annenkoff "is very like General Lord Wolseley in age, size, and personal appearance." Likewise evidently in—freedom from diffidence shall we say? His spurs are apparently the only drawbacks to his complete satisfaction with himself. He does not find them comfortable items of wearing apparel on a rough ballasted Railway track; but he never dreams even of such a remission of his duty to the Czar as would be involved in taking them off for half an hour. Mr. Stead does *not* explicitly say that he sleeps in them. Exalted virtue is silent about its own merits—sometimes. General Annenkoff obligingly told Mr. Stead he would undertake to deliver by rail at Candahar in nine days from London, and "this side up," English troops to any amount. Furthermore, he said that England and Russia are predestined by Fate, and the genius of the Steam Engine, to partition Afghanistan between them. "You will have to go" (i.e., to Afghanistan) he blandly remarked, "whether you like it or not. And why not? You are already in Beluchistan; it is all the same. You have your Railway at Quetta. You push it on to Pishin. You will soon have to make it run to Candahar. It is all simple and easy. Then from Candahar to the Russian frontier there will be only two stages. I can make the branch to Herat from Merv. You will join us there with your line coming from Candahar, and the thing is done. And when the Railway is made, there will be no more quarrels between England and Russia in Central Asia."

Evidently, people who are languishing in doubt as to the means by which the millenium is to be introduced into the nether world, need no longer travail in mental labor as to that detail. To all intents and purposes other than real ones, the wolf and the lamb, the lion and the bear have lain down together in amity. But—Railways commendable—without spurs—with them; and includes and longitudes, and surroundings are un-ious.

## Notes and Comments.

**A DRY DOCK FOR BOMBAY.**—A proposal for a dry dock at Bombay is included in the report of the Committee on the Navy Estimates.

**MERCHANDIZE MARKS ACT.**—In reply to a question in the House, Sir John Gorst said that Government had sent a despatch to India relative to the extension to India of the Merchandize Marks Act.

**LEAVE OF ABSENCE.**—We understand that Mr. Bartlett is officiating as Superintending Engineer, Eastern Section, Bengal-Nagpur Railway, *vice* Mr. Way, who has gone home on three months' leave.

**THE LIEUT.-GOVERNOR OF BENGAL AT RANEEGUNGE.**—During his visit to this town His Honor inspected the Potteries and expressed himself as greatly pleased with what he saw. In our next issue we hope to give a more detailed account of his visit.

**WHO IS TO BLAME?**—The Public Works Department at Mandalay had to pay a compensation of Rs. 3,000 to a Mr. Hugh Fraser, who fell into a hole excavated by the P. W. D., resulting in a broken leg, consequent on neglect on the part of the Department to fence in the excavation.

**A GOOD SELECTION.**—Mr. H. M. Mathews, late Engineer-in-Chief and Manager of the Burma State Railways, has accepted an offer from the Siamese Government to act in the capacity of Chief Engineer of Siam, and to superintend all the public works and railway operations of that country.

**WATER-SUPPLY IN THE BERARS.**—Mr. G. K. Watts, Assistant to the Superintending Engineer, P. W. D., at Bolarum, arrived at Amraoti, on "special duty," to report on the breach of the Badali tank. The gap has been repaired to admit of the residents having their water-supply restored to them.

**RAILWAYS IN PERSIA.**—According to the Russian papers Sir H. Drummond Wolff lately submitted to the Shah a project for a Railway from Teheran to the Persian Gulf. It would be constructed by a company which had also offered a million francs a year for all the customs duties on the Caspian and in the Gulf.

**A CHANGE FOR THE BETTER.**—The friends of Mr. Newton E. Jennings, late Port Engineer of Rangoon, will doubtless be glad to hear that that gentleman has been appointed a Shire Engineer in South Australia, after having been acting Engineer for some time in the City Surveyor's office in Prahra, Victoria.

**ANOTHER INVENTION.**—Mr. Wernigg, of the Burma State Railway, has designed an overhead crane worked from below for lifting logs to and fro in a saw-mill. They are supplied and manufactured by Messrs. Thomas Robinson and Sons, Rochdale. Eight of these cranes are now in Burma working very satisfactorily.

**IMPORTANT RULING.**—It is ordered that, without the special permission of the Government of India, no officer of Government in receipt of furlough or leave allowance may take service under any other employer in India, and no officer lent to any other employer in India can obtain leave allowance from the Government of India.

**THE E. I. R. DIVIDEND.**—A contemporary is struck with the fact of the complete dependence of the E. I. R. for the dividend it returns upon the accident of its fuel supply being so unprecedentedly cheap. But for this happy accident of a cheap fuel supply, there would have



been no profit, so far as it can see, on the year's traffic, but a heavy loss.

**A SENSIBLE ORDER.**—The Government of India has ordered that the P. W. Department in Upper Burma should relieve the Commissariat Department of the burden of supplying Barrack furniture. There is no Barrack Masters' Department in Burma, though it still exists in India; it might well be abolished and its duties transferred to the P. W. D. as an economical measure.

**SCIENCE AT A PREMIUM.**—The Indian Museum at Calcutta, containing the Geological Survey collections, was broken into through a window of the ground-floor gallery, and the show case, containing the fine collection of models of the great diamonds and other precious stones, was broken open, and the greater part of this collection abstracted. A similar disaster has also happened to the Colombo Museum.

**THE IRON TRADE AT HOME.**—Reporting on the condition of the iron trade during the half-year which has just closed, Messrs. William Fallows and Co. say there has been no improvement. The volume of trade has been large, but the results have been unsatisfactory to all concerned. Competition has been severe and prices have been forced down until, in many cases, they are below cost and generally unprofitable.

**UNDER-SECRETARY, IRRIGATION BRANCH, P. W. D. BENGAL.**—We had occasion recently to remark upon the anomaly of an officer doing double duty as Executive Engineer, Circular and Eastern Canals Division, and also as Under-Secretary in the Irrigation Branch. We now hear that Mr. Cecil Taylor has relieved Mr. G. Shawe in the charge of the Canals Division, and that this latter officer now gives his whole time to the duties of Under-Secretary.

**THE TRANS-CASPIAN RAILWAY.**—"General Annenkoff has, by the successful construction of the line, solved three important problems. He has found means of employing naphtha fuel in a country where neither wood nor coal could be had; he has found a way of supplying with a sufficiency of water a vast extent of country where natural sources do not exist; and lastly he has carried a line of Railway over such deserts of sand as are passed by no other railroad in the world."

**BOMBAY WATER-SUPPLY.**—From the reports of the condition of Malabar Hill and the Bhundarwada Reservoirs, it would seem that if the proposals of the Acting Municipal Commissioner for stopping the leakage and extending the area of the filter beds at both the reservoirs are sanctioned in full, the cost, according to present estimates, will be about six lakhs and a half of rupees, *plus* a considerable further outlay for improvements to the storage basin at the Malabar Hill Reservoir.

**BURMA'S NEED.**—As far as we can make out, there is nothing to hinder Burma's progress to a first-class agricultural position, save lack of labor. Machinery must be made to supplement it, and instead of shipping Indian emigrants to French settlements we should convey them and the labor of their hands to our newly acquired territory. They would be able to make more money than they can in the West Indies, and greater propinquity to the homeland will probably be an inducement to them.

**O TEMPORA! O MORES!**—Our Correspondent "Britannicus" wish is gratified and a scandal removed. The *Pioneer* says: That a soldier's latrine should be allowed to exist under the Willoughby tablet over the old magazine gateway at Delhi is not exactly in accordance with the

fitness of things—as was pointed out in this paper some time ago. We are glad to hear that the military authorities have at length made representations on the subject, and Government has now ordered the offence to be removed.

**THE DAMUDA BRIDGE, B.-N. R.**—It has now been definitely decided that the bridge will consist of 10 spans of 214 feet centres, with openings in the approaches at each end 100 feet long. The depth of the girders will be 18 feet 3 inches, and the greatest depth of foundation will not exceed 80 feet. The shore end piers will rest on rock foundation and the intermediate ones (6 in all) on wells. It is expected work will soon be put in hand in this connection, and the bridge will be an accomplished fact before 1891.

**A VERY SHORT-SIGHTED POLICY.**—A stretch of some 16 miles only separates Shoagyeen, the head-quarters town of the district by the same name, from the Rangoon-Toungchoo Railway. The Government have made a road over a great part of the way, but the Shoagyeen people complain that a road will not help their trade, and will cost as much to keep up as would pay the interest on the cost of a railway. The district supplies the finest fruit and betel-nut in the province, but the cost of bringing it to market is at present prohibitive.

**THE TRANSVAAL GOLD-FIELDS.**—The progress of these fields continues to strengthen the hope of those who entertain the belief that a remedy for depreciated silver is to be found in a greatly increased supply of gold. The Watersand is one of the auriferous districts that are now being exploited in the Transvaal. Mining operations were commenced there only two years ago, and already 1,015 stamps are working, and 795 stamps have been ordered, or are on the road. In a very short time, therefore, there will be 1,810 stamps at work.

**INDIAN POTTERY BAZAR.**—It is notified that permission has been given to Mr. T. N. Mukerjee, the well-known Curator of the Economic and Industrial Art Section of the Indian Museum, to open a small bazar in that building for the sale of the several varieties of Indian Art Pottery. There is no place in Bengal where one could see the work of the different localities and make a choice, and we therefore consider that this is a commendable move, and one that is likely to stir up the Bengalees to a sense of their deficiency in all that appertains to art.

**COAL IN THE FAR NORTH-WEST.**—The seam of coal along the edge of the Abbottabad and Murree Road has improved under further investigation. So far, the experimental workings have been merely surface scratchings, and it is impossible to judge of its commercial value until the seam has been followed up, to see if the quality continues to improve at a greater distance from the surface. The Punjab Government has been asked to give a small grant for testing this by a small shaft in the river Dhor itself, where the seam crops out 200 or 300 feet below the road.

**SPECULATIVE MADRAS.**—The cause of the mania for joint-stock companies which seized on the Madras Presidency two years ago, remarks an up-country paper, was never very clear; but those who actually embarked their capital, and not only their signatures, will now be in a position to realise their folly. Since the end of 1885, no less than 274 out of 375 companies registered at the time have disappeared, which means a collapse of 73.4 per cent. within two years, while of those whose liability is limited by guarantee, the percentage wound up is, we are told, even larger.



**THE E. I. R. EXTENSION BEYOND THE BURRAKUR RIVER.**—The local Government has called on the various Coal Companies and proprietors interested in the above extension, to guarantee the fixed Royalty of five annas per ton on all coal and coke sent over the projected line from any point thereof before the Syndicate will undertake the construction of the said extension. At this rate of Royalty it is expected the return of the line will be large enough to ensure  $4\frac{1}{2}$  per cent. on the capital, which, it is stated, will not exceed 11 lakhs of rupees in the event of the utilization of the girders promised from the Howrah District of the E. I. R.

**UNDER-SECRETARY, P. W. D., BENGAL.**—We recently stated that Mr. W. B. Bestic, the present Under-Secretary, proceeds on three months' privilege leave shortly, and speculation has been rife as to who will act during his absence. We could point to one or two officers who could be thought of in this connection, but they are far too fully occupied to undertake additional work. We have reason to believe that it is more than probable that Mr. W. Connan, an Executive Engineer, 1st grade, and Inspector of Local Works in the Presidency Commissionership, will carry on the duties in the Secretariat in addition to his present work.

**P. W. D. ESTABLISHMENT RE-ORGANIZATION.**—It is authoritatively stated that the report of the impending retrenchments in the *personnel* of the Public Works Department is much exaggerated. All that is being done is that an examination is being made into the cadres of the different branches of the Department with a view to future recruitment, as well as to ascertain the number of surplus men, if any work has been nearly finished, and it may happen that it will be found that the Department has some surplus men whom it may wish to retire if possible. But the number cannot be nearly so high as eighty, as has been stated.

**THE "UNCOVENANTED."**—"I find among the India Office Councillors," writes an influential Indian official now at home, "a wholly changed feeling towards the so-called Uncovenanted Services and a nearly unanimous desire to deal with them in a most liberal spirit. I fully believe that something will be done very soon, unless objections be raised in India, to protect pensioners from loss by the fall in the rupee." There is, the Allahabad paper suspects, no lack of sympathy on this side either; but the difficulty of giving a practical proof of it has kept the Government sympathy within bounds, as it has proved too strong in the end for the Secretary of State, who has been obliged, when it came to the point, to meet Mr. King with direct opposition.

**NEW MOVE IN THE WHEAT TRADE.**—Mr. Donald Smeaton some time ago drew attention to the enormous cost involved in the present method of carrying wheat and other food grains in bags to the port of shipment, and he urged the introduction of the American system of transport in bulk right down to the steamer's side. Merchants and Railway authorities have apparently not yet decided whether carriage in bulk is practicable; but the Bombay merchants are now thinking of utilising the railway siding which has been run into Prince's Dock for carrying the produce direct from the buying market to the ship. In this way the cost of godown establishment, and of cartage and handling involved in the movements between the consignee, the shipper, and the ship, would be saved.

**RAILWAY EXTRAVAGANCE IN BURMA.**—The *Rangoon Times* notices an advertisement inviting tenders for

the supply of 300 tons of teak-timber in *the log* for the Burma State Railway. It presumes that this timber is required for building carriages and wagons at Insein workshop, and if so, declares that a most extravagant measure is about to be adopted, and calls the Chief Commissioner's attention to the matter, since other Indian Railways understand the economy of procuring the requisite scantling cut to dimensions for such work; and when in Rangoon converted timber can be had in abundance from saw mills, it certainly appears a most insane idea to invest in logs from outside sources—particularly when the State is the largest holder of round logs in the country.

**ORIENTAL ARCHITECTURE IN SITAPUR.**—We glean that under Mr. Butt's careful direction the traders are fast replacing the ugly and ill-built ranges of buildings with shops and houses which, when completed, will make this market a pattern of what an Oriental bazar should be. Already the main street of the *ganj* is finished, and the *coup d'œil*, as one enters under the moresque archway at one end, is most striking and pleasing. Mr. Butt has wisely not insisted on any uniform pattern being adopted. He has, unconsciously following Mr. Growse's principle, left the builders to shape their frontage much after their own fashion. He has only besought them to follow, as much as possible, Oriental designs, and not to take as their models our D. P. W. structures. The result has been most successful.

**THE STORES DEPARTMENT OF THE INDIA OFFICE.**—The total expenditure of this Department in a year has not been definitely stated in any official record to which we have access, but the items under the head of "Stores" in the Home Accounts of the Secretary of State for the year 1886-87 amount £2,470,931, and with regard to every penny of this large sum the Government of India is prohibited from offering any remark by way of criticism. The Government has no guarantee that the purchases are made by experts at the lowest obtainable prices, nor has it any control over the actions of those officers of the Department whose favor is courted by sundry vendors. The "system" is thoroughly unsystematic, and it is idle to talk of retrenchments in India as long as this door for extravagance remains open.

**ALLAHABAD WATER-SUPPLY.**—We learn that good progress has been made in preparing estimates of the cost of the Allahabad water-works, and the leading points of the scheme will be placed before the Municipal Commissioners for settlement at an early date. Mr. Hughes's project is to pump water from the Jumna at Karela Bagh, and to deliver it into a settling-tank in or near the Khusroo Bagh. It will then be filtered and stored in a low-level underground reservoir. Another set of engines will then pick up the filtered water and distribute it at a suitable head of pressure thorough 15 miles of piping. Broadly put, the taxation required to meet the cost of the work, including interest and sinking fund and all working expenses, is from  $1\frac{1}{2}$  annas per head per month for a ten-gallon scheme to 2 annas per head per month for a 20-gallon.

**IRRIGATION ON NEW WORKS IN THE DECCAN AND GUJARAT FOR THE YEAR 1887-88.**—The total area irrigated during the year was 44,304 acres as compared with 40,903 acres in 1886-87 and 57,567 acres in 1885-86. It is satisfactory to find that the whole area for which water was applied for was brought under irrigation. The total area irrigated during the year, as compared with 1885-86,



shews a decrease of 13,263 acres, but as compared with 1886-87, there is a net increase of 3,401 acres, that on the Khari Cut, Bhatodi Tank, Nira Canal, Mhasvad Tank, and Gokak Canal, 1st Section, being particularly noticeable. There is a falling off in the irrigated area under some works, chiefly on the Mukti Tank, Ojhar Canal, Mutha Canals, Matoba Tank and Krishna Canal. Of the total irrigable area under command nearly 10 per cent. was irrigated during the year under report.

**RAILWAY ENGINEERS OF THE P. W. D.**—A Correspondent, writing to a contemporary on the Railway Engineers of the P. W. D., says:—In years to come, when the history of the Victorian era of public works in India is written, the work of the Engineers of this day will receive a far higher measure of appreciation than is accorded now, and I venture to think that, of the entire body of Engineers who will come to be recognised as among the most important scientific agents in the industrial civilisation now being founded, the Railway Engineers and the Irrigation Engineers will be considered to have led the van. Yet these Railway Engineers are now the most wretchedly paid, even of a poorly paid department, and, as "Falling Gradient" has shewn, even in their own Railway Branch Railway Engineers are being worse paid than Traffic and Accounts officials in that branch.

**THE BURMA LAND POLICY.**—If capital and labor is ever to be attracted to Burma, there is no doubt of the necessity for altering the present restrictive land laws in force. We have had some experience of them in most parts of Lower Burma for a generation and in some portions of Tenasserim since 1825. The result we see plainly enough. The increase of land taken up for paddy cultivation annually of late years is from 3 to 5 per cent., a rate of progress which will leave millions of acres still available for cultivation a hundred years hence. Unless we can make some more rapid progress than this in getting our waste lands taken up, the civilisation of the country will be retarded, and its scanty population not be stimulated to make the efforts they might otherwise be expected to do, to become producers of grain for export, and consumers of British imports, so constantly arriving by sea.

**NEW RAILWAYS IN NORTH-WESTERN INDIA.**—The estimated cost of the extension of the North-Western Railway from Sialkot to Jammu is Rs. 12,51,000, the entire distance being 24½ miles, of which 8½ pass through British territory, the remaining 16 miles running through the possessions of Cashmere. The Cashmere *Durbar* will supply the funds, but the working of the line will be entrusted at first to the North-Western Railway. The Punjab Government has issued orders for the survey of a line from Bhatinda to Minchinabad, a distance of 80 miles. The line forms part of the projected Railway between Bhatinda and Bahawalpore, a distance of 205 miles. This will shorten the journey now run by the North-Western Railway, between Umballa and Kurrachee *via* Mooltan, by about 127 miles, and the line will probably engross the greater part of the export traffic in grain from the Punjab, which now finds its outlet by the East Indian Railway.

**A RAILWAY ACCIDENT.**—We learn that a curious mishap occurred on the Northern Bengal Railway to the Sunday Darjeeling up-mail. The train was approaching Sultanpore, 60 miles from Sara, when the coupling of the carriage next the engine tender parted. The engine proceeded on, the Driver apparently unaware that he had lost his train, and the Guard equally ignorant that he had lost his engine. The engine slowed, and drew up at

Sultanpore. Shortly after the train, which was following with an accelerated motion owing to a slight incline towards the station, dashed into the engine and tender. Half-a-dozen carriages were derailed by the shock, and three rolled down the embankment. Fortunately, only one native passenger and a native Railway employé were in the first carriage that collided with the tender, and which was considerably smashed up. These two men are rather severely injured, but there were no further accidents.

**THE MYSORE P. W. D.**—Under the recent revision of the Public Works in Mysore, the Province is divided into eight Divisions, one for each District, each in charge of an Executive Engineer. Besides these Divisions there are three Special Divisions, *viz.*, the Mysore Special Improvements; the Astagram Channels and the Bridge Division. The Executive Engineers, of whom there are nine, are divided into four grades, one first grade on Rs. 750, two second on Rs. 600, three third grade Rs. 500, and three fourth grade on Rs. 400. The eight Executive Divisions are divided into 34 permanent Sub-Divisions, each in charge of an Assistant Engineer or Upper Subordinate. There are 12 Assistant Engineers in three grades, three in the first, four in the second, and five in the third grade. The Upper Subordinate establishment is made up of 36 members, of whom three were Supervisors, 1st grade, four in the second grade, five in the third grade, eight Overseers in the first grade, ten in the second and four in the third grade.

**THE ASSAM RAILWAYS AND TRADING COMPANY.**—The seventh Report of the Directors of the Assam Railway and Trading Company is more favorable than any yet issued, and seems to shew that the adventure is in a fair way to be profitable to the shareholders. But the working capital at the disposal of the Directors is not sufficient for the needs and the prospects of the Company. Capital is required for holding stocks of coal at such markets as Calcutta and Rangoon, and for enabling the Manager and the Agents to give the usual credits to customers. There are also the requirements connected with the development of the business as regards timber, petroleum and brick and tile making, and the provision which has to be made in the way of rolling-stock for a much more extensive output of coal than exists at present, to all of which must be added the expense of ballasting the Railway so as to lead to economy and efficiency in working. For all these purposes the Directors propose to increase the borrowing powers of the Company by £50,000.

**WOOD FUEL FOR RAILWAYS IN BURMA.**—The *Rangoon Gazette* thinks that wood fuel if used on a more extensive scale—it now apparently being only utilised for firing up purposes—would be "found cheaper than either coal or patent fuel which, at the present rate of exchange, costs in Burma Rs. 24 per ton." The *Rangoon Times* thinks there is something in this suggestion, whilst if the Railway purchased wood fuel all along the line, at stations where it was easily procurable, a large number of Burmans might be profitably employed in wood cutting. Between Toungoo and Pyinmana, for instance, there is no scarcity of wood, and doubtless in many other places between Pyinmana and Mandalay the same sort of forest prevails. Employment would thus be given to a large number of the inhabitants along the line, if this forest was utilised for fuel, whilst the cleared tracts would be available for cultivation as the population increased along the Railway, which it is sure to do directly through communication is opened between Rangoon and Mandalay.



**THE DHIKA GHAT, B.-N. R.**—We had the pleasure through the courtesy of the Resident Engineer, of visiting the works in progress at the Asansol end of the proposed Damuda Bridge, and from what we witnessed, there is no lack of energy in pushing forward the various preliminaries to the serious undertaking which will shortly be taken in hand. A neglected spot of barren rocks and eroded surface, conspicuous only for shingles and *detritus* not many months ago, is now one of great activity and bustle. Bungalows have been erected for the accommodation of the various officials connected with the prospective works, temporary sidings laid in to the store yard and to such works as are in progress, while round and about are evidences of great preparations against the coming event, of which these are the preliminaries. We were pleased with the temporary line which connects Dhika with Asansol, and considering that it is laid on the bare ground, made and natural, it has behaved remarkably well. The whole length—5½ miles—we were informed was laid in 12 days.

**THE WATER-SUPPLY OF TANJORE.**—The question of providing a supply of good water to the town of Tanjore has been under consideration for upwards of ten years. In 1888, Government placed at the disposal of the Municipality the services of Mr. W. Hughes, Executive Engineer, for preparing plans and estimates in connection with the water-supply project. Mr. Hughes has discussed three schemes. I.—Major Brockman's scheme (referred to above), which, complete, would cost Rs. 4,00,000. II.—The Pilliarpatti scheme (Mr. Hughes'), Rs. 90,400. III.—The Vennar scheme (Mr. Hughes'), Rs. 2,21,000. All these schemes have, on the ground of lack of funds, been rejected by the Tanjore Municipal Council. The papers have been referred to the Public Works Department, with the view that all the various schemes put forward may be carefully scrutinised and the objections to each fully stated. The Government has informed the Municipality that a refusal to carry out a well-considered water-supply scheme, simply on the ground of want of funds, cannot, therefore, be admitted, and if one of the existing projects is found worthy of adoption, the Council will probably be called upon to carry it out under sections 37 and 143 of the District Municipalities Act.

**INSPECTION OF THE INDIAN COAL MINES.**—The *Englishman* is much distressed regarding the want of inspection of our coal and other mines. It is evidently not aware that the question was discussed dry a couple years back. The *Pioneer* of the 27th January 1886 announced that "the Government of Bengal have officially intimated to the coal proprietary of the Province that 'the Government of India are of opinion that no present necessity exists for legislation on the subject of regulating the working of the coal mines in this country'—a conclusion that will be endorsed on all hands as a reasonable one. The conditions of mining in India are so totally different from those in England, that there is no case for the importation of the stringent regulations which are so ineffectual at home." The Government of India has definitely committed itself to an expression of opinion that *legislation is at present unnecessary* in connection with the working of the Indian coal mines, so that the *Englishman's* "ablest mining authority in India" will not be required to express an opinion on, or draw attention to the subject. The *Bombay Gazette* wisely declared that "the industry is only as yet in an embryo stage, and its first need is development, not restriction"; and we endorse its views.

## Current News.

FIFTY thousand cases of kerosine oil have been landed at Kurrachee from Batoum.

THROUGH communication between the West of India Portuguese and the Southern Mahratta Railways has been re-established.

IT has been decided to run refreshment cars with all mail trains between Sukkur and Kotri, on the North-Western Railway, from the 6th instant.

WE hear from Kohat that something is at last being done to put in order the road by Hangu to Thul, even though that something may not be much.

DURING the past quarter the Kidderpore Docks have made satisfactory progress. The total expenditure now amounts to over 97 lakhs, of which 23½ were for the land.

FROM a table published in the local *Gazette*, we learn that in June last the mean temperature at Allahabad exceeded that for the last 23 years by 3·6 degrees during the same month.

NO further attacks have been made on the Railway working parties at Chaman, precautions having been taken by the military to guard against another surprise by the local tribesmen.

IT is stated from authoritative sources that a survey of the route from Calicut to Cannanore is to be taken in view to the opening up of the latter town to Railway communication.

MR. FURNIVALL, Agent and Chief Engineer, N. G. S. Railway, is leaving almost immediately for Europe. He has left Simla already for Hyderabad to make arrangements for his departure.

THE Junaghur Railway line having just been completed will be opened for traffic after the Government Consulting Engineer passes it, and we shall thus be placed in direct communication with the chief State of Kattywar.

THE owners of native mills in Calcutta have formed themselves into an Association. There are at present 70 native mills in this city and the suburbs of Calcutta, and the new Association is to watch over their interests generally.

DURING the next cold weather an extensive Railway reconnaissance will be made in Upper Burma. The whole of the Mu Valley will be examined, and the country north towards Mogaung and Bhamo will be explored by a party of Engineers.

AMONG the questions which come before the Railway Conference is the proposal to establish only two classes of passenger carriages on the Indian Railways, on the system which has long been in force on the Midland Railway in England.

IN the Calcutta High Court the case of Dickson *vs.* the East Indian Railway Company was brought to a close last week. The Chief Justice, without calling for the reply on behalf of the East Indian Railway Co., upheld the decision of the Lower Court, and dismissed the appeal with costs.

A MEETING of Uncovenanted Civilians was held at Madras, on last Saturday, whereat the general feeling seemed to be that Mr. King put his recent motion in too direct a form, and that he would have done better to ask merely for a Committee of Inquiry. Mr. King will be asked to confine himself to this in the future.

THE Railway authorities are building at a great pace along the Siriab Road beyond Quetta station, and before the next year will be able to establish most of their offices up there. Building also is reported to be going on apace at the military end of the station; and when all is done Quetta will not be much less than three miles in length.

AT a meeting of the Uncovenanted Civilians, held at Simla, on last Saturday, Sir Guilford Molesworth in the chair, it was resolved to publish an explanatory pamphlet shewing exactly the effect of the fall of silver on pensions. This step has been taken with a view to gain public sympathy in England and support in Parliament.

IT is said that Mr. J. Eliot, Meteorological Reporter to the Government of India, is in Bombay on special duty, arranging a system of storm-warning signals in uniformity with that in use in the United Kingdom. Mr. Eliot works in conjunction with Sir Henry Morland, the Port Officer, while Mr. Frederick Chambers also materially assists him in the task.

THE result of a consultation between the Nizam's Minister and the Public Works authorities at Simla regarding Railway extension in the Hyderabad State, is likely to be that complete surveys and detailed estimates will be made of both the Raipur and Chanda lines. Until these are forthcoming no final decision as to which project should be adopted will be arrived at.



It is a curious circumstance that not a single head of the Revenue and Agricultural Department is at present at Simla. Mr. Lawrence represents the Secretariat, Mr. Dansey the Forest Department, Mr. Dallas the Meteorological, and Mr. Hodgson the Survey Department. If the juniors can manage so well there is surely room for economy somewhere.

The report of the Deputy Consulting Engineer to the Government of India for the half-year ending 30th June, 1888 on the Deoghur Railway is very favourable. The way and works are in good order, and the signals are in working order. The sleepers are in good condition and well packed, the running being smooth, and the line and stock have been well and efficiently maintained throughout.

OFFICERS employed with their Companies under the Military or Public Works Department, or on work that would ordinarily be performed by those departments, will not be allowed extra remuneration unless their duties extend beyond the supervision of their own men. But if an officer, in addition to the duties of his own Company, superintends the workmen and keeps the accounts of payments made to them, he may be allowed Rs. 2 a day extra.

THE Southern Mahratta Railway will shortly extend their line from Ghorpuri to the G. I. P. Railway station at Poona, which will be their terminal station. Near the latter the lines run parallel to those of the G. I. P. under a bridge which has already been built by the side of the one of the G. I. P. The S. M. R. station will be built opposite the G. I. P. and an overbridge will be built from one station to the other so as to allow passengers to pass from one platform to the other.

FURTHER details regarding the recent disturbances on the Khojak Railway, shew that they really owed their origin to a dispute regarding a contract for sand. The sand is situated within Afghanistan, and the Afghans naturally desired to be permitted to contract to carry it to the Railway. The consequence was that when the selected contractor went for sand, the Afghans refused to allow him to take it, and, as is usual and customary, a free fight occurred, and several hard knocks were given and received.

## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*

### INFORMATION WANTED.

SIR,—Could you oblige through your valuable weekly with any information about *Elastic Railway Couplings*.

J. N. DUTT.

TINDARIA; July 31.

### THE BURRAKUR WATER-LIFT.

SIR,—Referring to your issue of the 21st July, I would request you to kindly give, if convenient, the full description and plan of the Burrakur water-lift—price, Rs. 35 to 55—in your Journal. The lift being a cheap one many farmers would, I believe, be willing to make use of it, provided there is nothing that requires skilled labor to put it in repairs.

HATHIRAM CRICKAMJI.

KUTCH BHUJ; July 28.

### ANSWER TO "LIFT PUMP."

SIR,—I see in your issue of 4th August a letter signed by a correspondent calling himself "Lift Pump."

He informs your readers that the "mining community in the district are in throes of expectation, as it has been announced that a well-known hydraulic Engineer is now engaged perfecting a pump which is to revolutionize the hitherto accepted theory and practice of hydraulic Engineering."

He further tries to give your readers a hazy idea of what the invention is, and thereby, not only betrays his ignorance of the invention, but goes further by making out the inventor to be ignorant of the first laws of mechanics.

What induced your correspondent to rush into print with these mis-statements is quite unanswerable.

The invention in question is at present under experiment, and so far has proved a success in regard to its working; but owing to other important duties, the trials have been suspended for a time.

In conclusion, allow me to inform "Lift Pump"—1st.—That the inventor has no intention of revolutionizing the hitherto accepted theory and practice of hydraulics.

2nd.—That the mining community in the district know little or nothing about the invention, as the inventor has only shewn it to one or two of his own personal friends.

3rd.—That the inventor strongly advises "Lift Pump" in future to be well acquainted with the subject he writes about, before misleading the public with his hazy effusions.

RARA AVIS.

### THE PEOPLE REALLY TO BLAME.

SIR,—The Lords of the Admiralty have been sharply criticized and blamed of late for not having a fleet at sea sufficient in the number of vessels composing it to enable Britannia to make sure of ruling the waves, as of yore. But it would appear that the Armstrongs, Whitworths and other big gun manufacturers are the people really to blame for this falling away from precedent and righteousness. The ironclads *Collingwood*, *Howe*, *Camperdown*, *Anson* and *Undaunted* are ready for sea; but their guns are not ready for them; and

O ye gods and little fishes

What's a frigate without gun breeches?

Big guns for the Navy have been growing more and more expensive every year of late. The accounts of the Royal Gun Factory at Woolwich shew that the 13½ inch gun turned out last year cost £10,859 12s. 7d. It is a 67-ton breechloader, throwing a shot of 1,250lbs., with a powder charge of 630lbs. Such charges, monetary and material, are solid facts that almost persuade us to believe in Dr. Cumming's apocalyptic conception that the millenium is near at hand. That is to say, that if the present rate of progress and cost in warlike armament continues much longer, international wars must needs come to an end—firstly, for the reason that the most bellicose of nations will be unable to afford their expense; secondly, because when a cannon ball can carry wholesale destruction much farther than the 7 miles which are now its limit, the game will have become too scientific in popular estimation to be worth the candles—too much of a certainty to admit of "the glorious chances of war." And bets on a certainty don't count; and there's no fun in them either. Wherefore Bismarck's occupation as "an honest broker," and fomenting of brawls will be gone—his and that of his successors in the function. And the evergreen Grand Old Man will rub his hands, and give a hitch to his high shirt collar and remark complacently—*Ego feci, Pax vobiscum!*

EGOMET.

### MOORE'S IMPROVED CAST-IRON SLEEPER.

SIR,—I hope "Railroader" will excuse my not replying sooner to his last letter.

1. As regards wear and tear of the rail due from oxidation, I did not, of course, mean that there would be no oxidation, but nothing like to the extent that thin steel sleepers attached both sides are liable to.

As regards the grooving of rails by ordinary cast-iron, I acknowledge to have seen this in old iron rails with badly designed, narrow-seated chairs, but never with steel rails; and I have turned iron rails that have been in the road over 12 years without a single mark on them, where broad-seated chairs had been used.

2. I am aware, as "Railroader" states, of the forces tending to raise and displace the rail; but I am of an opinion that if the sleeper is properly packed, the downward pressure more than neutralizes these forces, and taking a sleeper badly packed, it will, I think, be found that the jaws are strong enough for the work they have to do. At any rate, this point will soon be settled, as some are now being cast for trial.

3. The D. and O. sleeper, no doubt, does occasionally break crossways, but the breakage from this and other causes is under 1 per cent. per annum. In my design, the rail being so much lower, there is not the same leverage tendency to break it in this manner.

4. "Railroader" does not press this objection, so I say no more.

5. Regarding the friction between the end of the tie-bar and the web of the rail, "Railroader" states that, be the amount however small, it may lead to disturbance of the originally accurate gauge. I still maintain that the amount will be so infinitesimal that it may be disregarded.

In conclusion, I hope, in a future issue, to be able to give drawings of a new design I have got out for metre-gauge sleepers on altogether a different system, and shall be glad to have "Railroader's" intelligent criticism on it.

G. E. MOORE.

### DO THE FINE ARTS FLOURISH IN BENGAL?

SIR,—In order to answer this question one would require to know what percentage of people in Calcutta, as the seat of literature and art on this side of India, pursue any of the branches of Fine Art, or to have outward proof that an active interest is taken in their promotion. As regards the former, no one can contest the fact that among both the residents of Calcutta and its regular cold weather visitors, there is talent of a very high order, as many of the exhibits in the Simla and other picture exhibitions prove; but of outward evidence concerning it we have none.

Now, considering the very beneficial influence which works of art exercise in the minds of people of both high and low degree, can it be conceived that the metropolis of India, with its large and wealthy mercantile, trading, native and its important official communities, is so sleepy, so devoid of pride, so indifferent to its position as the centre of civilization in the East, that it can afford to look on unmoved at second and third rate towns like Bombay, Madras, Poona, Simla, Lahore, Mussoorie, &c., bringing together objects of æsthetic interest for pleasure and enlightenment. Diversions of this class are few enough and far enough between.



During the charming days of December and January what a want is felt for some place of fresh interest where a few hours of harmless pleasure can be derived! Besides this some direct incentive is necessary in order to encourage artistic pursuits, and this can be supplied by such a society as we advocate.

Calcutta very greatly needs, and should without further loss of time be provided with, a Society of Fine Arts. There are doubtless very many people who would support such an institution, both pecuniarily and practically, and I would suggest that the movement should have associated with it the present Superintendent of the School of Art, as the central figure of the art section in Calcutta; its success would then be almost assured. A strong local committee of ladies and gentlemen could easily be formed with the object of managing such a society. I wish it were in my power to utter the thinking words which could awaken the Province to a perception as to its backwardness in the more refined arts. It is too sleepy, too regardless of its own prominence in these fast moving times, when cities vie with each other for the premier position in this large Eastern Empire. Here is one of many outward visible signs by which Calcutta's rivals may gauge its claim to remain for all time the metropolis of India—let us have it so by right and not by accident.

ART-UNION.

### LIMES AND CEMENTS.

I.

SIR,—I have read "Eureka's" letter in your issue of 7th July and it conclusively shews that there is no fixed ratio between the weight and quantity in different qualities of gooting lime, and that the variation in these ratios is much larger than is generally known, so that any publication, such as P. W. D. Schedules of Rates which do not contain provision for these differences, cannot be accurate for even the limited area of one division of Public Works.

2. I examine the contents of several hundred waggons, loaded with gooting lime, every month. I dig down to the floor of the load in three or four places and mix the stuff so taken out and dissolve a hundred grains of the sample. If the insoluble residue so found, i.e., if everything taken together, which is not lime, in the sample exceeds 33 per cent. of the weight, the lime is rejected, however excellent the appearances may be. This test was adopted because the occasional analysis of the lime formerly tendered, shewed, that such residue often went up to 80 per cent., while 40 per cent. was about the best quality. This test was so searching that quite 50 per cent. of all lime tendered was rejected and it took a long time to get contractors to improve their manufacture, so as to reduce the rejections to 15 per cent., about which figure it now oscillates, with this difference, that the lime rejected is very far superior to what was formerly the case. In addition to this test, the freshness, dryness and fineness of the lime are subject to arbitrary judgment.

3. The driest looking lime will contain 3 per cent. of moisture, and everything in excess of this is redundant, though in the rains it is impossible to secure lime nearly as dry as this; we then draw the line at 12 per cent. of moisture. When 10 per cent. of moisture is present, the dampness is very apparent; and when it contains 16 per cent., the lime is quite discolored and looks like wet sand. Fineness and purity generally go together, but not always. A very poor gooting lime may be sifted till it is as fine as emery powder and it will still shew over 40 per cent. of residue, but the finer lime in each sample will contain much less residue than the coarser. The 33 per cent. residue test requires so much screening of the lime as to make it as fine as it can possibly be required for use. Our standard of fineness is regulated by a screen of 10 meshes to the inch, but this test has never been applied. When a residue test is not possible, then a high standard of fineness is advisable, bearing in mind that unless the gooting is good, this won't secure lime of a high standard, nor when the lime is adulterated with calcareous earths, which contain 80 per cent. of residue, but give a lovely softness and fineness to the adulterated composition.

4. It is impossible to fix any standard of color for gooting limes. When they are pure, it passes from very light grey to even a dirty light red, the latter color being due to the formation of the gooting in soils containing iron, or to smoke in the kilns, or to rains checking the uniform progress of the firing. It is never white like Kutni, or Sylhet, or pure limes. When there is a pale lemon tint perceptible, it is due to the presence of earths used as adulterants. Those conversant with gooting lime manufacture will have noticed that the calcined materials are violently beaten with clubs after slaking—this is to disengage and pulverise the partially burned stuff which does not flake off, and to increase the out-turn of the kiln. The products of such manipulation are of course almost useless, as lime, whatever part they may take in enabling the well burned slaked lime afterwards to set into strong mortar, a function whose value has not so far as I know been determined like that of sand or other materials. Natives of India believe very much in its strengthening properties, and it is I think calculated to be of greater value than sand or soorkee as a component part of mortar. It is quite certain that the quantity of it present in pure slaked lime is an element to be considered in determining the proportions of sand and soorkee to be used, and it is equally certain that the fact of its presence has never

been thought of in the preparation of some of the best specimens of mortar in the country.

5. "Eureka" points out that a 33 per cent. residue test is not in itself conclusive of the value of your lime. Strictly speaking, it is not; but comparatively speaking, it is. Without it, I have shewn that no one knows what materials he is using; with it, one can determine in the first place the proper proportions of sand or soorkee. The test determines the relative purity of the limes used; it indirectly regulates the fineness; and the use of the same acids in another way will indicate whether the lime is serviceable or not; for dead lime and insufficiently burned lime will comport themselves very differently from good lime in acid solutions. The weakness of the test lies in this, it is just possible to mix very fat lime with other substances, such as sand and earth, and pass it off as gooting, but more possible to mix fat limes with nearly useless gooting limes; but there is a possibility of fraud being practised in every trade. It is the probability of it that should be our guide. Let us estimate the chances. If the lime from an exceedingly fat lime stone, which contains not less than 10 per cent., of insoluble residue be mixed in the proportions of 80 of lime to 20 of extraneous matter, the insoluble residue would probably slightly exceed 33 per cent. Therefore, nothing short of lime made from marble, calcite, or Sylhet and Kutni limestones would answer the purpose of simple mixture with worthless materials, but the cost of such excludes their use. Impure Indian limestones contain at least 10 per cent. residue. The stratum of chalk, through which the borings for the proposed Channel Tunnel took place, contains 10 per cent. The average good gooting of India contains about 30 per cent. of residue, i.e., 20 sand and 10 clay; and I have never met with any gooting lime, although prepared from the fattest quality and carefully protected from all contact with ash that gave lime of better quality than 14 per cent. residue. Such gooting lime will bear about 20 per cent., of sand, but where is such gooting to be got in sufficient quantities, and where is there in India a manufactory where it could be burned like pottery? Even in the district where this very rich gooting is to be obtained, there is not enough to admit of its being adulterated with extraneous substances. It may occasionally be used to improve the outturn of poor gooting, but if this were the case, it would be a legitimate admixture, and that it is not the case is proved by the habitual failure of other gooting limes made in the same neighbourhood to pass a 33 per cent. test. That pure lime is never used to adulterate gooting limes is pretty certain, for in this district where calcite abounds and real limestone, their cost is too great to admit of it, while in Calcutta, where Sylhet lime is sold at from Rs. 90 to Rs. 100 a 100 maunds, and the best gooting limes at Rs. 45, it is quite clear that no such admixture can possibly pay.

R. C. M.

### THE PUNJAB AND ORIENTAL OIL COMPANY (LIMITED)

SIR,—Mr. John Noble, of Petrolia, Ontario, U. S. A., has been granted a concession to work the earth-oil deposits of the Punjab, Government receiving, by way of land revenue, 5 per cent. of all the crude earth-oil obtained, and claiming nothing more than this in the way of Royalties. The terms are fairly liberal, and the Punjab and Oriental Oil Company, Limited, whose representative Mr. Noble is, starts under favorable auspices. The Company is a Syndicate of Canadian capitalists. Mr. Noble is an oil refiner of great experience in America, and has associated with him in the Punjab venture six petroleum experts, owners of four-fifths of the Company's stock, which is composed of 2,500 shares of Rs. 100 each. It seems to me a good augury for success, that men so largely and directly interested in it, are to be directly concerned also with the conduct of its affairs. Too many limited companies fail, all the world over, because of a lack of personal interest, personal responsibility, on the part of their working agents. A corporation, Sydney Smith said, has neither a body to be kicked, nor a soul to be damned. Neither can it bring to bear such influence on the managers of its affairs as the owner of property can, who comes into constant contact with them, and can run no risk of being ever regarded in lazy hours as an abstraction, and a decent excuse for taking things easily. At the same time the advantages of co-operation of limited companies, properly worked, are too obvious to need demonstration. The Punjab and Oriental Oil Company contrives to combine the advantages of both systems; the resources and divisions of risk that pertain to a company, and the thorough supervision of affairs seldom thoroughly practised, except by working agents, largely interested in results.

A capital of two and a half lakhs of rupees has been deemed sufficient to "strike oil" with, and after such assurance of well doing, the Company is expected to be self-supporting, dividend-yielding. Meanwhile, the Government of India has conceded to Mr. Noble specially low rates of freight for five years, over all Railways controlled by the State, for his oil, plant, &c.

In the event of oil being struck in large quantities, Government will erect works at Rawal Pindi or some other suitable place on the North-Western Railway, for the manufacture of kerosine and Railway lubricating oil, a certain quantity of which latter will be purchased every year, for five years, at the rate now paid for the castor-oil used for lubricating purposes by the different Indian Railways. Tank wagons will be supplied to the North-Western Railway, so that the oil may be distributed in bulk, after the



manner so successfully followed in Russia, by Messrs. Nobel Brothers, of dynamite fame.

The *Pioneer* suggests that one great advantage the Punjab and Oriental Oil Company will enjoy lies in the close proximity of its oil-fields to the densely populated central portion of India, where there is likely to be a market of large capacities. Your contemporary says:—"The freight inland from Bombay and Calcutta on American and Russian oil is so great for that long distance, that it will be equal to a protective tariff for the Company." The Punjab oil-fields are intermediate as it were between those of Baku and Burma. Experts hold that they are similar in formation to those of Baku. The North-Western Railway runs right through the centre of them. The first well will be arranged for at a place called Fatehjung, thirty miles west of Rawal Pindi, where now oil may be seen oozing out of the saturated ground. Mr. Marvin, in his book, *The region of eternal fire*, says that the Baku wells are worked at a depth of from 300 to 800 feet, and that when oil is struck the force of gas from below is frequently so great as to blow heavy drilling tools and apparatus out of the hole made by them, into space. Describing an oil fountain at Baku, he writes:—

"At 420 feet there was a terrific outburst of gas, which was repeated at 490 feet; the oil each time mounting to the surface, but disappearing after the cap was fixed. The third time at 546 feet, the explosion of gas was terrific, hurling the pumping cylinder into the air, and smashing the top of the derrick pieces. Afterwards dry sand began to spout with terrible force forming a fountain of grit from 350 to 400 feet high. Bits of rock were hurled so high as to be lost to sight: all the windows of the neighbouring engine houses were smashed, and the metal roof of a boiler house was broken through by a falling stone. This 'sand-volcano' lasted 45 minutes, and was succeeded by a blast of gas which poisoned the atmosphere at Balakhani the rest of the day. After a considerable time a cap was fixed on the tube and directly afterwards the oil began to spout."

The best thing Mr. Marvin can do with himself now, or at least shortly, is to take a trip to the Punjab and give an account in his graphic style of the triumphs of the Punjab and Oriental Oil Company, Limited. Science and commonsense seem to be agreed that failure is out of the question. Under the Company's terms of agreement with the Government, none of the original stock-holders can assign or sell their stock to an outsider without Government's consent to such transfer. This condition has been insisted on in order to prevent the shares of the Company falling into the hands of speculators and jobbers, and to secure the development of the oil trade of the Punjab at the hands of experts. The agreement between the Government of India and Mr. Noble, dated 23rd March 1888, has received the sanction of the Secretary of State, Lord Cross, and there is nothing now to prevent an immediate commencement of operations on the Company's part, as soon as the necessary machinery arrives *in situ*.

ENTERPRISE.

## Literary Notices.

### THE NORTH-WESTERN PROVINCES RAILWAY TRADE REPORT FOR 1886-87.

THIS Report is dated December 1887. It deals with the official year ending with the 31st March, and it is comforting in these days of financial pressure to be assured that the value of both imports and exports shews an increase over that of the preceding twelve months. This most desirable result has come to pass in spite of a decrease in the weight of exports of over 12 lakhs of maunds, and is adjudged as due to the fact that decrease has, in the main, been restricted to articles of low value, compensated by a comparatively small increase in some of the more costly products carried by the iron horse. The gain in quality has more than atoned for depreciation of quantity. The total value of exports during the year exceeded that of imports by over ten lakhs of rupees; and it is written:—"If the value of Railway plant and rolling-stock be excluded from both exports and imports, the balance in favor of exports amounts to one crore and twenty-three lakhs of rupees." That is a result upon which Indian traders may fairly be congratulated. It remains for them to go on, and win such of the world's markets as are open to legitimate competition.

We note that the Agra Division contributed nearly 56 per cent. of the total exports of that staple. The wheat trade of 1885-86 is said to have been advantaged by exceptionally favorable cir-

cumstances. The crop was a very fine one, and a steady demand for it set in from home, on account of short supplies in America coupled with low rates of exchange, and cheap freights.

The harvest outcome of the succeeding year was not so good, and exports consequently fell off. Those of the year under review are over 26 per cent. in excess of the average quantity exported since 1879-80. Indigo fell considerably short of normal conditions of export.

As to oil seeds, we are told that the improvement occurred chiefly in linseed, rapeseed and castor. Most of the increase in linseed happened in the export to Bombay, as a result of a bad crop in the Central Provinces. The increase in rapeseed was shared between Calcutta and Bombay almost in equal proportions, and was due to less exports of this seed from the Punjab. The increase in castor was confined to Calcutta; trade in this seed with Calcutta appears to be of a very recent date, there being no export of it in the year 1884-85. Linseed was drawn mostly from Allahabad, Benares and Oudh. Rapeseed was supplied mostly from Allahabad and Oudh, and castor from the Agra and Allahabad Divisions.

An increase in import of cotton goods will probably please manufacturers at Manchester, but will scarcely seem as satisfactory to Anglo-Indians when it is noted that cotton goods of Indian manufacture "fell off by over 46 per cent." India needs developments for her own trade, and not so much the encouragement of foreign markets.

Of metals, iron shews the greatest increase in the way of imports; the places importing most of it were Agra and Allahabad.

The decrease shewn in the export and the increase in the import of opium is held to represent merely movements of crude drug between the Ghazee-pore and Patna Factories. Increase of sugar exports is set down to the credit of Rohilkhand, the 1886 crop there having been a very flourishing one. Increase under the heading "Salt" is said to be due to sparse supplies in the previous year occasioned by the damage sustained by the Sambhar Works. The local deficiency was recruited by sea salt from the Bombay Presidency.

Madras secured no less than 88 per cent. of the total trade in undressed sheep skins it seems, at present; but the North-Western Provinces and Oudh are increasing their business in this direction. Each succeeding year shews improvement.

Taking the entire province, it is satisfactory to note that the railborne traffic of the year under review shews considerable improvement, and is an indication of increased prosperity.

## New Books and Reprints.

### CHEMISTRY AND PHYSICS.

BOGGETT (W.) Key to the Mysteries of Water, Electricity and Heat Cr. 8vo Triebner ... 1. ; 1/6

MITCHELL (John) A Manual of Practical Assaying. Edit. by William Crookes, 6th ed., Illust. with 201 Woodcuts. 8vo. pp. 330 Longmans ... 31/6

PHYSICAL Memoirs. Selected and Translated from Foreign Sources under the Direction of the Physical Society of London. Vol. 1, Pt. 1. Roy. 8vo. Taylor and Francis ... 4/

THOMSON (J. J.) Applications of Dynamics to Physics and Chemistry With Diagrams. Cr. 8vo. Macmillan ... 7/6

### MATHEMATICS.

CASEY (John) A Treatise on Plane Trigonometry; Containing an Account of Hyperbolic Functions. With numerous Examples. Post 8vo, pp. 276. Hodges (Dublin). Longmans ... 7/6

COMMERCIAL Mathematics. Part 1, Arithmetic, Including Foreign Monies, Weights and Measures. Part 2, Algebra. Post 8vo, pp. 100 Longmans ... 1/

MOFFATT'S Elements of Euclid, Books 1 and 2, and Elementary Mensuration; with Explanatory Notes, Exercises and Deductions worked out as Models, 3rd ed, revised and enlarged. 8vo, pp. 206. Moffatt and Paige ... 2/



## General Articles.

### A WESTERN BENGAL RAILWAY.

A RAILWAY project—already noticed in this Journal—of very great importance to Bengal—has lately been put before the Secretary of State, by the Oudh and Rohilkund Railway Company, under the auspices of Sir Bradford Leslie, and with the title of the "Western Bengal Railway." It is proposed, as our map shews, to make this the connecting link between the Oudh and Rohilkund Railway and Calcutta, by a direct line from Benares, through Gya, Byjnath and the Sonthal country to Cutwa, Kulna and Hooghly. The project appears to us to be an excellent one, both as regards its financial prospects and its aspect as a second and much needed line to Calcutta from the North-West. We are informed that the scheme was originally proposed to the Government of Bengal by Mr. H. Bell, Manager of the Tirhoot Railway, now at home on leave, and that it has been readily accepted by the Oudh and Rohilkund Railway as a basis for the reconstruction of the Company. Sir Bradford Leslie's memorandum on the project, which we also publish, gives briefly, but clearly, the main features and advantages of the proposal, and it is one that should receive the unqualified support of the Government of Bengal. It would open up an immense area of the province now completely shut out from Railway communication, and result in throwing a great increase of produce into the Calcutta market. We would urge that no time be lost in having surveys and estimates made by Government of the project.

### MEMORANDUM RELATIVE TO PROPOSED WESTERN BENGAL RAILWAY.

THE proposed extension of the Oudh and Rohilkund Railway to Howrah and Calcutta would run from Mogul Serai *via* Sasseram, Gya, Baidyanath, Sooree, Ahmoopore, Cutwa, Nuddea and Kulna, to a junction with the East Indian Railway at Hooghly, affording communication with Howrah and *via* the Jubilee Bridge with Calcutta.

2. The total distance from Mogul Serai to Howrah would be 450 miles, but the actual length of Railway to be constructed would be 425 miles, and the cost, including stock for local traffic, Rs. 90,000 per mile, total, say Rs. 382½ lakhs. or £2,550,000 sterling.

3. Excepting the bridge over the Sone River, there would be no works of extraordinary magnitude.

4. It is believed that the gradients would not be less favourable than on the East Indian Railway.

5. The proposed line would connect the three chief places of Hindoo pilgrimage, Benares, Gya and Baidyanath, by a direct route, saving the pilgrim traffic a detour of 150 miles *via* Patna, and avoiding the changing carriages at Patna, a most troublesome ordeal to Zenana females; and while keeping clear of the difficult gradients of the Hazaribagh district, the line would serve the northern flank of the Chota-Nagpore plateau, the great recruiting territory for the coolie labor of Assam, the Mauritius, and the West Indies.

6. The proposed line would also afford the most direct route between the great rice producing districts of Beerbhoom and Burdwan and Benares. The consumption of rice in the North-West Provinces and the Punjab is steadily increasing, and this is certain to be a very valuable traffic. The proposed line would further fulfil a great want in providing the important towns of Cutwa, Nuddea and Kulna with Railway communication with Calcutta, Howrah and Upper India.

7. In normal seasons the average through goods traffic between Benares and Howrah is not less than 100,000 tons per annum; and this traffic, which would properly belong to the extension of the Oudh and Rohilkund Railway, is certain to increase, consequent on the opening of the Dufferin Bridge.

8. At the average rate of earnings on the East Indian Railway, 100,000 tons carried 450 miles would produce 14 lakhs of rupees.

9. The local goods traffic from the rich producing districts of Behar and Shahabad, fertilized by the Sone irrigation canals, would be very valuable. There would also be a large traffic in lime from Rhotasgurb, which would probably supersede the Kutni and Sylhet lime in the Calcutta market. The rice traffic between Ahmoopore and stations below and Benares, already referred to, would be another source of revenue, and the portion of the line running through the Burdwan and Nuddea districts would contribute a fair amount of goods traffic both up and down. On the whole the local goods traffic may be assumed at not less than Rs. 50 per mile per week.

10. The passenger traffic of the proposed line affording an absolutely direct route both from Upper India and Lower Bengal to the much frequented shrines of Baidyanath, Gya and Benares, and also affording the natural outlet for the coolie emigration traffic of Chota-Nagpore, cannot fail to be very heavy; there will further be a very large local passenger traffic between Kutwa and stations below and Calcutta. The average receipts of the East Indian Railway from passenger traffic are not less than Rs. 160 per mile per week, and on the Bengal division are very much greater, so that it may be very safely assumed that the passenger traffic of the proposed line will be at least Rs. 100 per mile per week; making Rs. 150 per mile per week as the total local traffic of the proposed line. This, which is considerably less than the traffic of the Patna, Gya, and Tarkessur branches of the East Indian Railway, is a very low estimate.

11. Rs. 150 per mile per week would give Rs. 33 lakhs per annum, on the 425 miles between Mogul Serai and Hooghly, making, with the through goods traffic, a total of 47 lakhs.

12. With working expenses at 40 per cent., and considering the advantage of being part of a large concern, and of cheap fuel from the Bengali coal-fields, they should not exceed this ratio; a traffic of Rs. 47 lakhs would yield a net profit of Rs. 28 lakhs, equal to 7½ per cent. on the capital outlay of Rs. 382½ lakhs.

13. But it will be said all this traffic is to be taken from the East Indian Railway. This, however, is not the case, the only traffic taken from the East Indian Railway would be the Rs. 14 lakhs of through goods between Benares and Howrah, and some portion of the pilgrim traffic, on the other hand the East Indian Railway would benefit by the carriage of the material and of coal, for the proposed line, and by the interchange of traffic with that line at Hooghly, Ahmoopore, Baidyanath, Gya, and Mogul Serai, and it is probable that the new traffic thus developed would more than compensate for the loss of the through goods between Mogul Serai and Howrah.

14. The East Indian Railway follows the course of the Ganges, which forms the northern boundary of what is called Western Bengal, a territory of 60,000 square miles, with 22 millions of inhabitants, and it cannot be contended that this large country, equal in area and population to England and Wales combined, is adequately served by the 701 miles of the East Indian Railway, which runs hundreds of miles away from some of its most fertile tracts.

15. The following table, prepared from the most recent official information, shews that, whether as regards area or population, Bengal is lamentably deficient in Railway communications, as compared with the other principal Provinces of India:—

	Miles of Railway open.	Square miles of Territory per mile of Railway.	No. of Inhabitants per mile of Railway.
Punjab	1,950	73	11,647
Bombay	2,196	94	11,573
Madras	1,544	98	22,600
N.-W. Provinces	1,484	75	30,222
Bengal	1,574	119	44,177

In this table Assam is excluded from Bengal; if that Province were added, the deficiency of Bengal would be still more striking.

16. The East Indian Railway yields a net return of Rs. 313 lakhs per annum, equal to an average profit of 8½ per cent. between Delhi and Howrah, and on the Bengal division the profit must be over 12 per cent. per annum, so that it may well afford to spare a few lakhs in the interests of the vast outlying districts and of trade generally, which can only be properly served by a second line.

17. In the event of the East Indian Railway being breached by an extraordinary flood above Lucki Serai, the relief afforded to the East Indian Railway by an alternative route for its traffic, even for a few weeks, would compensate for any loss of traffic it might sustain for many years.

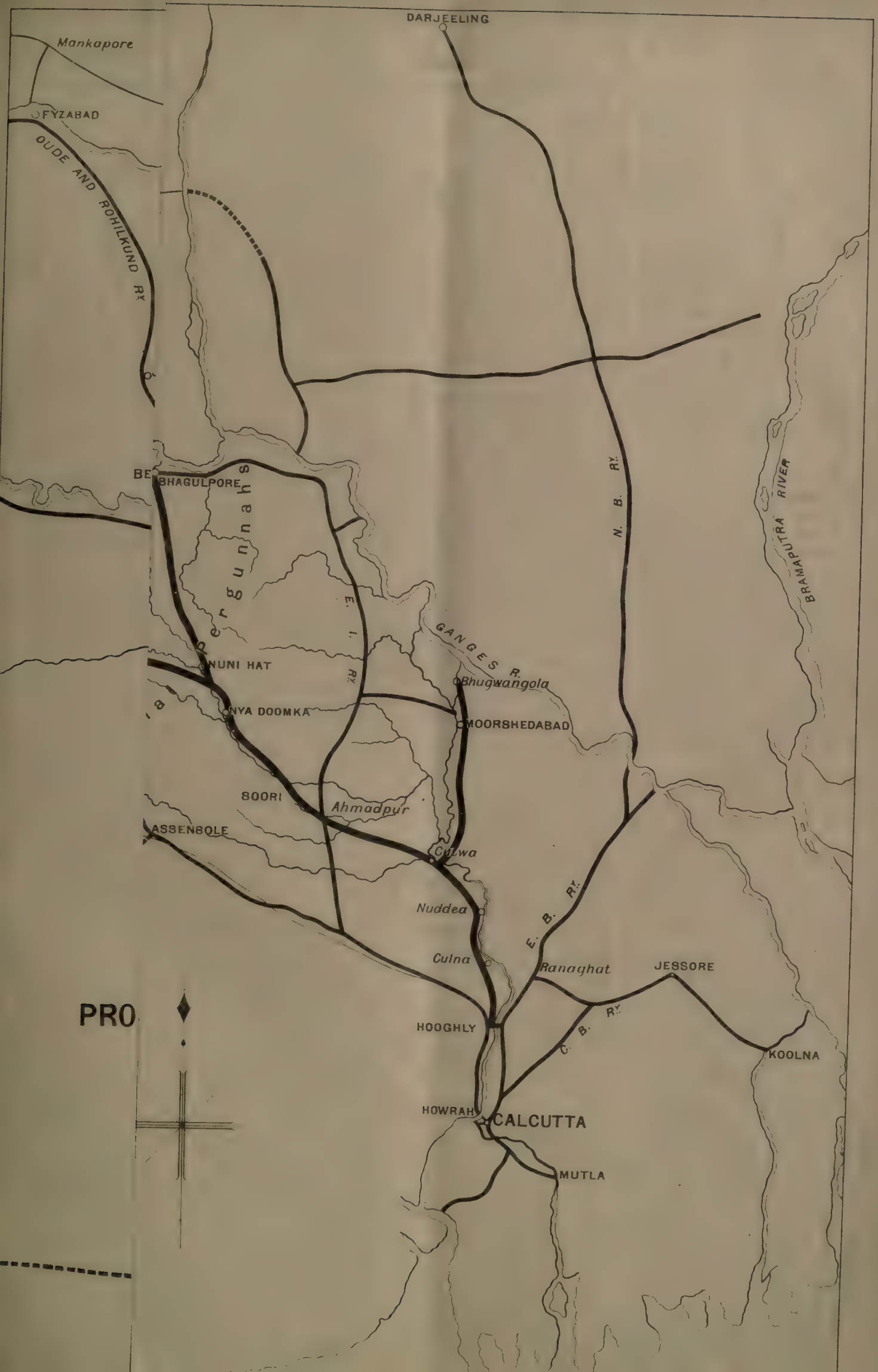
18. The proposed line would also include a branch of 56 miles in length through the Sonthal District to Bhagulpore, and a branch of 40 miles to Bhagwangola, both of these branches would serve fertile and populous districts hitherto unprovided with Railway communication, and would be remunerative additions to the project, but to simplify the matter, the present memorandum deals only with the question of the extension of the Oudh and Rohilkund Railway from Mogul Serai to Hooghly.

19. By arrangement with the Bengal and North-Western Railway Company, the proposed line might, at an inconsiderable increase of expenditure, provide space on its road bed and at stations for the metre gauge railway from Gya to Hooghly. It would then only remain for the Bengal and North-Western Railway to lay their line from Bankipore to Gya, and thence along the proposed line to Howrah to get direct access to Calcutta.

BRADFORD LESLIE.

June 11, 1888.











## NOTES ON NAVIGATION.

BY A. EWBank.

## III.

In the preceding paper we had a rhumb line  $FACB$  which was drawn so as to pass through two given points  $A, B$ . These points are in north latitude. They have different longitudes, and the latitude of  $B$  exceeds that of  $A$ . In such a case  $\gamma$ , the "course," is an acute angle.

If we produce the rhumb line beyond  $F$ , we shall reach the Equator in a point  $M$ . Every rhumb line in which  $\gamma$  is an acute angle intersects the Equator. If we still continue the rhumb line, it passes into south latitudes and forms a second spiral which embraces the South Pole.

At the point  $M$  the curve has what is called a point of inflexion. North of  $M$  the curve is, so to say, convex to the South Pole. South of  $M$  it becomes concave to the South Pole.

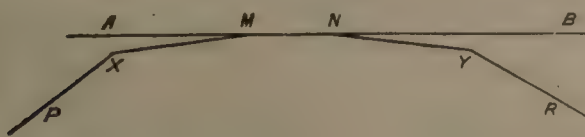
When we draw any plane curve such as a circle or ellipse, we may take a point on it, and there draw the tangent line. Let this line be  $AMB$ . Let  $X$  and  $Y$  be two points on the curve near to  $M$  and on opposite sides of  $M$ . Then  $X$  and  $Y$  are on the same side of the line  $AMB$ .

If a curved line passing through  $M$  has a point of inflexion there, then  $X$  and  $Y$  are on opposite sides of the line  $AMB$ . Thus the tangent line appears to cut the curve.

This appearance of cutting is due to the fact that in our early studies of mathematics we are usually given incorrect ideas about tangent lines. Thus we are told by Euclid that a line touches a circle if it meets the circle, but does not cut it. Or we are told that a tangent line is a line which meets a curve in one point only.

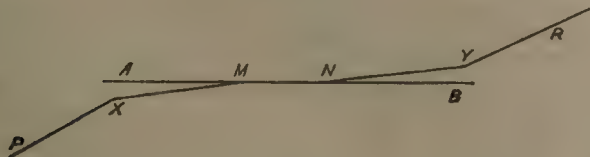
The first statement would not necessarily be true if we replace the word circle by the word curve, unless we carefully distinguish between cutting and crossing. The second statement is never true.

Fig. 4.



To illustrate these points let us consider fig. 4 and fig. 5.

Fig. 5.



In fig. 4  $PXMNYR$  is a part of a polygon, and  $AMNB$  is a straight line. This line may be said to touch a polygon. A line may be said to touch the polygon when one of the sides of the polygon is an element or portion of the line.

Let us imagine the sides of the polygon to be made continually smaller, and at the same time let the successive interior angles of the polygon—viz., the angles  $PXM$ ,  $XMN$ ,  $MNY$ , &c.—be supposed to approach  $180^\circ$ . Then the polygon approaches to a curve. During this process the point  $N$  approaches the point  $M$ .

The line  $AB$  remains immovable, and the point  $M$  in it remains fixed. Ultimately  $N$  becomes not coincident with  $M$ , but consecutive to it.  $M$  and  $N$  remain distinct points, no matter how close they may be. The points  $M$  and  $N$  define the direction of the line as well as do the points  $A$  and  $B$ . But if  $N$  become coincident with  $M$ , the direction of the line  $AB$  would become indeterminate.

In fig. 4 the points  $X$  and  $Y$  are on the same side of the line  $AB$  which touches the curve at a point  $M$  which lies between  $X$  and  $Y$ . This is in fact the usual case when a straight line touches a curve.

Let us now apply similar considerations to the polygon in fig. 5. We shall ultimately have a curve such as is denoted in fig. 6. Here  $MN$  is an infinitesimal arc of the curve. This arc consists as it were of two points only. It has ends as it were, but no middle, or the middle is the space between two consecutive points.

The curve  $PXM$  is convex to the line  $AB$ . The direction of the curve has gradually changed from  $PQ$  at the point  $P$  to  $MB$  at the point  $M$ . Whether the curve will continue to flex in the same way as indicated by the dotted curve  $NGH$ , or whether it will at  $M$  begin to flex in the opposite direction as  $NYR$ , is clearly a matter in which we must leave the curve to obey its own laws.

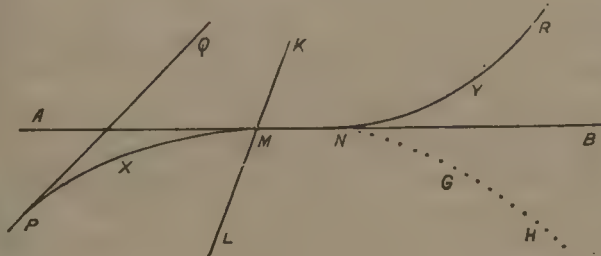
If it flexes like  $NGH$ , it will leave its tangent line  $MN$  on the same side as it approached this tangent line. If it flexes like  $NYR$ , it will approach the tangent line on one side, and will leave it on the other side.

But the line  $AMNB$  is in the latter case none the less a tangent line at  $M$ . It does no less faithfully describe the direction of the curve at  $M$ . It does accurately describe the direction of motion at  $M$  of a moving particle which travels along the curve from the point  $P$  to the point  $R$ . And it would not be correct to say that  $AB$  cuts the curve  $PMR$ . A line only cuts a curve at  $M$  when the direction of the line differs from the direction of the curve at  $M$ . Such a cutting line like  $KML$  passes through  $M$ , but does not pass through  $N$ .

To resume then—a line cuts a curve when it meets it in one point. A line touches a curve when it meets it in two consecutive points.

The line might possibly meet the curve in three consecutive points. This would however only be possible with certain curves, and at particular points of those curves. It would never be possible with a circle or ellipse. But this is exactly what does happen with the curve in fig. 6.

Fig. 6.



When we apply algebra to the study of such a curve, we discover that there is a third point  $O$  consecutive to  $N$ , and such that  $M, N, O$ , are in one straight line. Accordingly the line  $AB$  meets the curve in three consecutive points. In other words, the tangent  $AMNB$  is not less closely identified with the curve—than would be the case in an ordinary circle—but is really more closely identified with it.

This is usually expressed as follows: Let  $S$  and  $M$  be two points of a curve. Let  $S$  be an ordinary point and  $M$  a point of inflexion. Let  $CSD$  be the tangent line at  $S$ , and  $AMB$  the tangent line at  $M$ . Then the contact of  $AMB$  with the curve is of a higher order than is the contact of  $CSD$ .

Thus the rhumb line which crosses the Equator at a point  $M$  has there a point of inflexion, and when we have understood how to draw a tangent to a rhumb line, we shall see that the tangent at  $M$  is closer to the curve than would be the tangent at any other point of the rhumb line.

Let then  $MABG$  be a portion of a rhumb line starting from a point  $M$  on the Equator and passing into the northern hemisphere. Its angle  $\gamma$  would in a treatise on curves be called a parameter of the curve. By varying  $\gamma$  we do not cease to have a rhumb line, but we have a



different one from the former. In our case  $\gamma$ , the parameter is a certain acute angle. We may suppose it to differ notably from  $90^\circ$ . It may thus be  $30^\circ$  or  $60^\circ$ .

If the point M be given and also the parameter  $\gamma$ , the rhumb line is completely determined. If we vary M on the Equator, but keep  $\gamma$  constant, we obtain a precisely equal rhumb line in a different position. If we vary  $\gamma$  with or without variation of M, we obtain a second rhumb line which is neither equal nor similar to the former.

In plane geometry we have such things as similar polygons and similar curves. On the sphere there is no such thing as similarity. There may be equality of areas simultaneously with equality of sides and of angles. But equality of angles—the essential characteristic of similarity—cannot exist on the sphere apart from equality of curved lengths.

Thus the shape of a rhumb line depends only on the value of  $\gamma$ .

### NOTES ON INSPECTION OF THE DARJEE- LING-HIMALAYAN RAILWAY.

By COLONEL, A. LE MESSURIER, R.E.,

*Officiating Consulting Engineer for Railways, Calcutta.*

THE following particulars were gathered from some papers supplied by Mr. Prestage:—

A narrow gauge (2' 0") line constructed by an "Assisted Company" on the cart-road from Silligori to Darjeeling (51½ miles), under an agreement between the Secretary of State for India and "the Darjeeling Steam Tramway Company, Limited," dated 8th April 1879.

The Secretary of State guarantees the yearly gross receipts to the sum of 2 lakhs of rupees, and after the tramway has been opened for five years, receives half the profits in excess of 5 per cent. towards the maintenance of the road and repayment of the guarantee.

There are two Government *ex-officio* Directors, but when the gross traffic receipts exceed 2 lakhs for the year, the main rights and powers of the Secretary of State under certain clauses are suspended.

The Secretary of State has the right, after the tramway has been opened 25 years, and thereafter, at terms of 10 years each, to take it over on giving 12 months' notice, and on paying the value of the property as dividend-paying investment, plus 20 per cent.

The date of first opening to traffic was 23rd August 1880, and of formal opening on 4th July 1881.

The description of the cart-road carrying the Darjeeling Himalayan Railway is very clearly given in an Inspection Report by the Chief Engineer, Bengal, wherein it is shewn that the Railway runs for 36 miles on the road, and for 15 miles over loops, reverses and diversions of separate construction.

The Terai Section, from Silligori to Sukna, is 7 miles in length, with an average rise of 1 in 293. The Hill Section, from Sukna to Darjeeling, is 44 miles long, with average gradients varying from 1 in 29 to 1 in 35, rising for 40½ miles to Ghoom Station, the highest point, 7,438 feet above the sea, and falling for 3½ miles into Darjeeling. The maximum grade being shewn at 1 in 28, and the maximum curve of 70 feet radius excepting at the loops, where the radius is 60. (At loop No. 4 this radius is continued for 150 degrees).

There are no complete plans and sections of the Railway; those with the Resident Engineer at Tindaria, shewing the alignment for 32 miles from Sukna to Kurseong, are not corrected to date. For the remaining portion there are some old sections which give the grades as steep 1 in 22.29, 22.39, 23.04, 23.47 in the 48 miles, &c., &c. In fact proper plans and sections are not forthcoming either for inspection or record.

Other essential records are also apparently not available for reference—notably a diagram of moving dimensions; a standard section to which the Railway is to be maintained; a specification as to the nature of ballast, &c.

The lithographed maps, which have lately been pre-

pared on a scale of ½ mile to an inch, are inferior. The impressions are too much mixed up with unimportant detail, and give but a poor idea of such an interesting engineering undertaking. Moreover the locations of the stations at Ghoom and Tindaria are wrongly shewn, and nearly a mile out of position.

As regards the Terai Section.

At Silligori terminus the goods-shed seemed to be most inconveniently placed. It is a large temporary structure of corrugated-iron, flanked on both sides by carriage sidings; it contains an office, and from its position and surroundings is more than liable to accident from fire.

Full information regarding the Mahanuddi bridge will be found in the Report by Chief-Engineer, Bengal, (referred to). The original timber structure cost Rs. 70,000 in 1868; it was strengthened in 1879, and the repairs since 1884 are estimated at Rs. 24,000. A new bridge of iron is contemplated at an approximate cost of 1½ lakh rupees.

The Mahanuddi bridge, at time of inspection, was under heavy repair, and there was undoubtedly a difficulty in executing these repairs while the bridge was in use for Railway traffic. The timbers below river-bed were said to be in excellent condition. My present impression is that it would be better to abandon all idea of partial and progressive repair; to thoroughly overhaul the present wooden structure from end to end, to rebuild it right away above river-bed level, and to defer the erection of an entirely new bridge on a different pattern. The Railway for the time being (during next cold weather) could be carried across the river on a diversion without inconvenience, and probably for 30,000 or say 40,000 rupees the bridge could be re-erected in three months to last 20, 30 or 40 years more. The supervision of this re-construction should not, however, fall on the Resident Engineer, as he has plenty to occupy his constant attention on other parts of the line.

The Panchanai bridge is described in the Chief Engineer, Bengal's report, and when the necessity for any large repairs may become apparent, it should be dealt with in the outright manner suggested for the Mahanuddi. The value of the timber condemned for use in the large bridges will not be lost, for the beams, &c., will still be available for repairs of the smaller openings.

About ¼ of a mile south of Panchanai Station has been relaid with the heavier section of 40lb rails. The old 30lb. rails are continued over the rest of the section, and apparently nothing has been determined with a view to complete the renewals at the rate of 2 miles yearly, as noticed in the Report by the Chief Engineer, Bengal.

One of the miles was traversed by a trolley in 2½ minutes, or at the rate of 24 miles in the hour.

As regards the Hill or Upper Section.

The line runs in a notherly direction, with heavy grades, passing Loop No. 1 to Rungtong Station at the 12th mile. It then strikes west to Loop No. 2 at the 14th mile.

The timber trestle at this point 12' x 12', independent of the old bridge, has been erected as a precautionary measure (some struts are wanting), and the design for the tunnel costing Rs. 10,000 or 12,000, seems altogether the most suitable for the locality. The water which used to cause the slip near the tunnel is to be arrested above bridge, and will be diverted to the east.

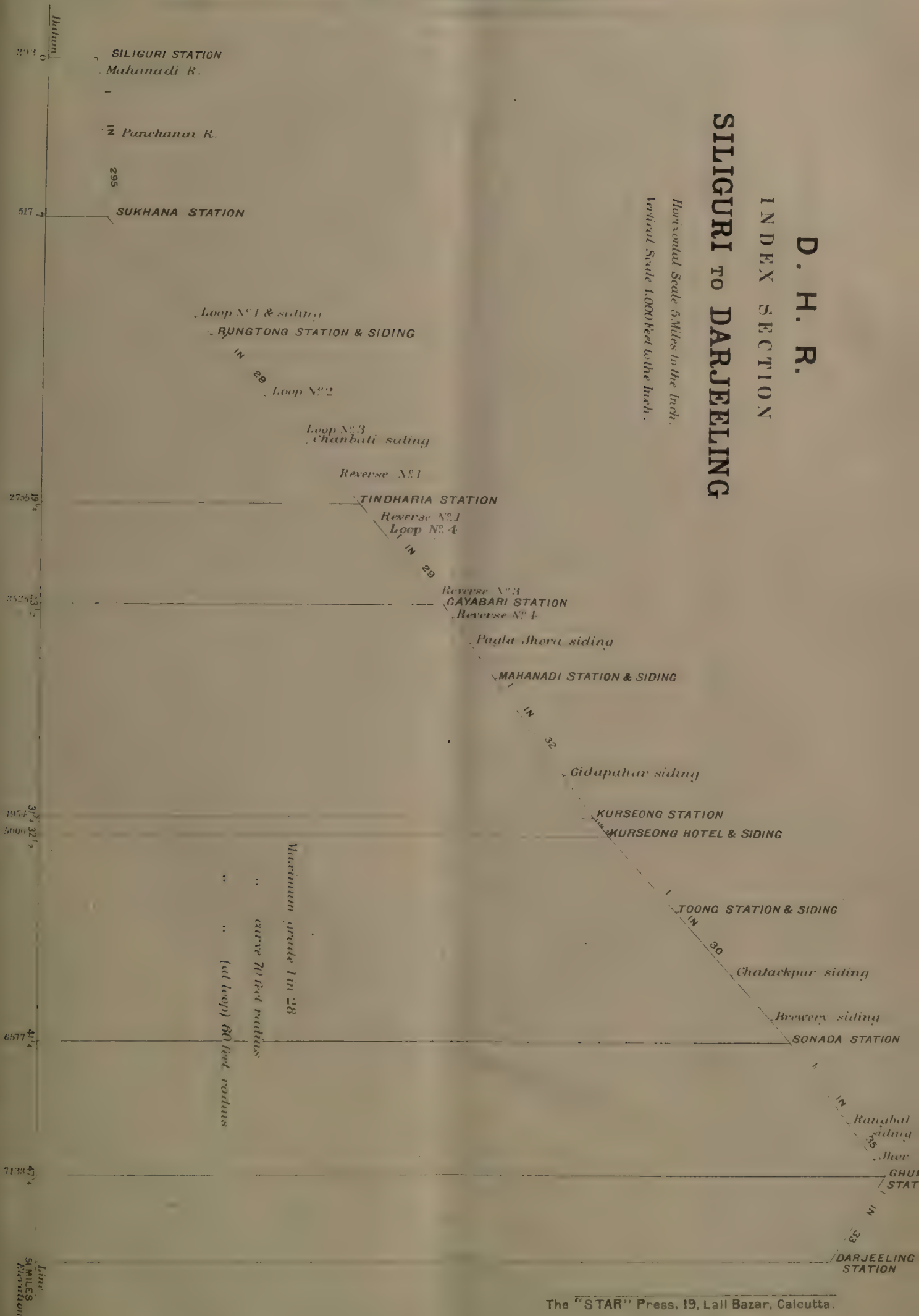
Loop No. 3 is at 16th mile, Reverse No. 1 at 17½ miles, and Tindaria Station at 19½ miles. At Tindaria the settlement still continues; the surface waters have been diverted; the station building itself has now been divided into two; rails have been placed beneath the building, and as settlement occurs so will the station house and offices be raised to proper level.

The head-quarters of the Resident Engineer are at Tindaria, and there also are the workshops under a Locomotive Foreman. The shops are small, chiefly constructed of corrugated iron, and are said to be sufficient for the purpose. The engine wheels run from 10 to 15,000 miles, and the flanges are then worn out. The engine wheels when new are 1' 8½" between the wheels, the flanges are 1½" and the treads 3½". The gauge at curves is laid ¼" loose so that new



D. H. R.  
INDEX SECTION  
SILIGURI TO DARJEELING

Horizontal Scale 5 Miles to the Inch.  
Vertical Scale 1,000 Feet to the Inch.









wheels will have a 1" play, but when the flanges are worn away to a  $\frac{1}{4}$ " the play will then be as much as 3". And if the flange is flush with the outer rail, the bearing of the tread on the inner rail will be limited to  $1\frac{3}{4}$ ". The marks on the track clearly shew, also, that the inner flange must travel from 3 to  $3\frac{1}{2}$ " within the track. The wheels of the engines are fixed, and also those on the trollies. These engines weigh about 12 tons. They carry 325 gallons of water, and consume from 40 to 50 gallons per mile. The consumption of coal is about 40lb. per mile. In the vehicle and goods stock there is one loose wheel on each axle.

The tare of a high-sided covered goods wagon to carry 100 maunds (say 4 tons) was given at  $1\frac{1}{16}$  tons. There are no appliances such as weighbridges, &c., for ascertaining the tare of the stock.

Soon after leaving Tindaria the line at  $20\frac{1}{2}$  miles enters the drainage of the Sibakhola river. A deep valley, or more correctly speaking, an amphitheatre, extending northwards for about 3 miles, and with a breadth of  $1\frac{1}{2}$  mile, fringed and overlooked by hills of a considerable height. The Railway is contained in this valley for 9 miles till it crosses the spur into the next valley at Giddapahar siding. It first runs to the west past Reverse No. 2, through Loop No. 4, and then at 22 miles, it turns northwards, still following the watershed, through Reverse No. 3, Gyabari Station, and Reverse No. 4 up to Pagla Jhora Station at the 25th mile.

At this point is, what may be described as the great reverse, wherein the line is carried to the east for 2 miles to Gumti point overlooking the Mahanuddi valley, and back again for nearly 3 miles on the same slopes at a higher level to Giddapaha.

Above Tindari the line in many places is not maintained to any standard, that is to say, the line is permitted to approach and crown the crest of the slope, so much so that in places the ends of the sleepers project into the air, and to a certain extent overhang the hill side. This evil is also in some places aggravated by villagers, who, in making short cuts, have worn away or trodden down whatever little formation may have existed at the ridges of the spurs. These omissions, and many others of minor detail, indicate clearly the necessity for a strict observance of some standard plan of construction. The alignment through the Mahanuddi bazar monopolizes, to all intents, the public road.

*(To be continued.)*

#### AMERICAN ENGINEERING NEWS.

*(From our own Correspondent.)*

DURING the recent great storm or "blizzard" which struck New York and its vicinity, and completely shut out that great city from the outside world, so to speak, the practical value of the new system of telegraphy, by which messages can be sent from moving trains, was well illustrated by its workings on the Lehigh Valley Railroad. On account of the severe storm and high winds all the regular telegraph lines were down. The new line has been in use for about a year upon the New Jersey Division from Perth Amboy to Easton (a distance of 70 miles), and it proved of great value to the road. In an accident during the storm, the induction train telegraph operator was on board and at once telegraphed back for a wrecking train. Within a short time it arrived with the Division Superintendent, and during the day messages were sent to and from the wrecking train and surgical relief was obtained. All the delayed passenger trains were equipped with the new system, and located each other by means of the new system; provisions were called for and received; belated passengers sent dispatches to their homes, and all the manifold business of railroading was carried on with celerity. The poles used to carry the line are only sixteen feet high, and they expose little surface to the storm. The messages are transmitted by induction from the metal roof of the car to the line, a distance of ten feet, and when the cars and line were both buried in the drifts no inconvenience was suffered. The dry snow acted as a good insulator. During this great storm, the only news for three days New York City received from Boston was *via* London per Atlantic Cable.

There has been so much said lately against the Count de

Lesseps and his Panama Canal in the public prints of this country, and in lectures and papers read before Scientific Societies, that it is refreshing, even only for a change, to see a good word spoken about it. Colonel Alfred L. Rives, M. Am. Soc. C.E., now Superintendent of the Panama Railway Company, has recently visited Panama and the Isthmus to rectify certain abuses in the management of his Company's affairs. Colonel Rives is an able Engineer and a thorough practical man. He was for many years Chief Engineer, and General Superintendent of Mobile and Ohio Railroad, and was recently Vice-President of the Richmond and Danville System. He says that some day people will become convinced that the reports about the Panama Canal and the climate have been false or exaggerated. It is not a paradise of course; neither is the Isthmus a line of malarial swamps, and any man of good health and sound body can live there as well as in his own land if he takes good care of himself. It is the fault of the workmen themselves that sickness and death occur. They are not sufficiently careful of themselves, about their diet and exposure to dampness. Pay day is the worst evil. This occurs twice a month, and many of the workmen will insist upon going on speers. On the Railway the health of the sober employes has been just what it would be in the North. Dissipation is more trouble than anything else. The illness from fever occurs in the interior, but it generally prostrates only those who abuse themselves. Under similar conditions the Europeans seem to succumb sooner than the Americans.

The Panama Railway runs between Panama and Aspinwall, a distance of forty-seven miles, and does a business of \$300,000,000 a year. Besides ocean tramps, as they are called, there are ten steamship lines that connect with the road. Seven touch at Aspinwall; three are English; one German; one French; one Spanish; and one American. At Panama there are three; one the Pacific Mail, going North, and two under South American control connecting with the South. Not a day passes but at least one steamer lands at Aspinwall.

The great Sweet Water dam and National City water-works at San Dugo, Cal., have recently been completed. The dam is of solid masonry, built across Sweet Water Valley in order to form a large reservoir for the purpose of storing water for the dry season. The dam is ninety feet high from the base by twenty feet. The area of the reservoir is 750 acres, and the cost of the dam was \$800,000.

The past few years have witnessed considerable railroad building in the west and south-west of this country. This year the prospect of railroad construction is not quite as bright as has been predicted, but there will undoubtedly be many miles of road constructed. The labor troubles of the past year, and the closeness of the money market, have had a tendency to interfere with the plans of nearly all railroad managers.

Probably one of the most important moves to Kansas City, will be the construction by the Missouri Pacific of a line from Carthage, Missouri, to Bald Knob, Arkansas. When completed, it will be a parallel line to the gulf route, and will be a short and direct outlet for the product of Southern Kansas and Colorado to the consuming regions of the south. This company will also construct two lines, one to Nevada, to make a short line from Southern Kansas to St. Louis, and the other to Carthage, to make a short line from Texas to St. Louis.

The Santa Fé will build no important trunk lines, but will make extensions to nearly all the branch lines, especially those in Western Kansas. The Minneapolis branch will be extended north-west about 100 miles, to mark out a path for emigration in some of the new counties in the State. A short time since it was rumored that this road was looking for a terminus in New York City, and said that a lease of the New York, Pennsylvania and Ohio Railroad and the New York, Lake Erie and Western Railroad was about to be made to effect that purpose.

The seventeenth meeting of the American Society of Mechanical Engineers was held recently in the City of Nashville, Tenn., and was, from all accounts, a very successful meeting. Some of the papers read were: *Proportioning Steam Cylinders*; R. H. Thurston: *Warming Cars by Steam*; Wm. J. Baldwin: *A Safety Car Heating System*; H. R. Founé: *Strains in Locomotive Boilers*; L. S. Randolph: *The best form of Nozzles and Diverging Tubes*; A. F. Nagle: and many other papers on interesting subjects.



## BURMA.

(From our own Correspondent.)

In consequence of the extra trains required to run between Rangoon and Insein causing a rush, often attended with danger, the Supreme Government, on the recommendation of the local authorities, has sanctioned another narrow gauge line of Railway to the latter station: a distance of 9 miles.

The evil effects of entrusting smiths to work in metal, without being acquainted with its quality, was rather apparent in a recent transaction: when Government purchased a large quantity of steel from one of the firms for a local factory, and when a portion of it was tried, it was not found to suit its purpose, and the consequence was, that the steel was returned as bad. The question was of course disputed, and the manufacture was then conducted under the supervision of a foreman smith from the firm: who proved by test and workmanship, that the metal was not subjected to a proper treatment before being manufactured, and hence resulted in a failure. He followed up by conducting a series of trials, when a number of steel bars were subjected to different degrees of temper or hardness, and forged into their respective suitable manufactures. Of the various degrees of temper, some were made soft, some medium, and some hard, and he shewed the temperature of heat necessary for converting it into different tempers, and to this want of knowledge he attributed the bad workmanship of smiths in this country. He also proved that by a gradual process of heating, good steel can be turned out; but not as is the general custom in subjecting the metal to the same temperature throughout, and constantly applying water to lower the heat, which results in the steel becoming burnt and turned into oxide of iron. He further attributes the brittleness of most of the Indian manufactures to the fact, that the steel has been hardened to too high a heat, for the percentage of carbon it contained.

The local Government is now engaged in settling the vexed question of the nature of buildings, now being erected by grasping landlords, which has been reported by the sanitary authorities of Rangoon to be the chief cause of the periodical epidemics prevailing in this town. All the new buildings are now being constructed into barracks, some containing as many as 60 rooms, each inhabited by 20 or 25 coolies. As the law now stands, the Municipality, or the Health Officer, has no power to prevent the nuisance, although it has been represented, beyond a doubt, that such buildings are a nuisance, and the dens of sickness to the neighbourhood. The question is one of the utmost importance affecting the public, and is therefore entitled to consideration. The landlords, so far, have had things their own way, but we await the results of Government inquiry. Although undue diligence is given in inspecting and surveying plans, &c., it would appear that no attention is paid to sanitation, and since the Health Officer's reports are unnoticed, it is high time Government should interfere in the matter.

The position which Burma occupies among other mineral producing countries is not all that her most enthusiastic admirers represent. There is no doubt, however, that it has vast resources, both mineral and agricultural. A well-informed expert, after alluding to the distressing circumstances which attended the recent failures in oil-boring in Arracan, the efforts of the Lead Mining Company in Tennasserim, and the depression which till recently existed in the different companies prospecting for coal in this Province, was induced to say (from the many applications now being made for mining leases) that "a mining and boring boom is on just now," and he attributes the rage not to any special desire of the lessees themselves working concessions, but merely to obtain grants for the purpose of floating companies and personally swelling their own pockets, and materially staking the interests of the country. He positively asserts that a travelling acquaintance of his, clears as much as £5,000 per mensem for being instrumental in launching mining operations in different quarters. We trust that the Government will be cautious in granting mining concessions, particularly after the sad experiences of the past few years.

The Chinese are now becoming such adepts in drawing on stone and in chalk drawings (specimens of which have lately been sent home) that a brief description will perhaps be interesting. The drawings are usually done in crayon, made quite greasy, darkened with lampblack, and specially manufactured by themselves. The composition consists of four parts of wax, two parts tallow soap, two parts of gum lac and enough lamp-

black to make a dark tint. The stones having been previously made smooth, are grained with very fine sand, the sand being sifted to prevent the least particle of grit; water is then added, and the graining stone pressed rapidly over the sand and water with a circular motion, adding more water from time to time until the graining stone ceases to move rapidly, and the surface gets quite smooth. The stone is then washed and dried; if any scratches appear on the face, it should be gently smoothened with a pumice stone till the scratches disappear. After the stone is prepared, an outline of the drawing required is made on tracing paper. A piece of soft paper is rubbed in well with powdered red chalk and placed on the grained surface of the stone. The tracing is placed face downwards and the outline is marked with a smooth pointed instrument through the transparent paper. When this is finished, an exact copy of the tracing will be left on the stone backwards. The same process is gone through with all kinds of drawings and writings on stone. When an alteration is necessary, remove it with a scraper, taking care not to cut that portion deeper than the surface; as the drawings will not be sufficiently worked out. In this manner some excellent drawings have been turned out, and John, with his usual ingenuity, is now about to compete with the Western World.

## The Gazettes.

## PUBLIC WORKS DEPARTMENT.

Mysore, July 28, 1888.

Mr. A. Govindacharlu, Assistant Engineer, Ashtagram Channel Division, is granted privilege leave for 3 months, with effect from the 10th September or date of departure.

The 20 days' privilege leave granted to Mr. C. B. Halagaiyagauda, Assistant Engineer, Tumkur Division, in this Office Notification, dated 25th May last, is hereby cancelled at his request.

Madras, July 31, 1888.

Captain W. D. Lindley, R.E., Assistant Engineer, 1st grade, passed the departmental standard examination in Tamil on the 16th July 1888.

The following transfers and postings are ordered at the public expense:—

Mr. A. S. Russell, Executive Engineer, 3rd grade, sub. *pro tem.*, from the Tinnevely Division to No. 2 Periyar Project Division.

Mr. C. A. B. Target, Executive Engineer, 1st grade, from No. 2 Periyar Project Division to the North Arcot Division.

Mr. A. H. Garrett, Executive Engineer, 3rd grade, from the Bellary Division to the Tanjore Division.

Mr. H. W. Clift, Executive Engineer, 1st grade, on the Government of India list, to the Bellary Division.

Mr. J. C. Johnston, Executive Engineer, 3rd grade, from the Cuddapah Division to the Tinnevely Division.

Mr. J. D. Davies, Executive Engineer, 3rd grade, on the Government of India list, to the Cuddapah Division.

Mr. C. A. Smith, Executive Engineer, 4th grade, temporary rank, from the North Arcot Division to the Coimbatore Division.

Mr. H. Phillips, Assistant Engineer, 1st grade, on the Government of India list, to the Nellore Division.

Bombay, August 2, 1888.

The promotion of Lieutenant-Colonel J. D. Cruickshank, R.E., to the temporary rank of Superintending Engineer, 2nd class, should have effect from the date on which he took charge of the duties of the Superintending Engineer, Southern Division, *viz.*, the 13th May 1888, instead of from 3rd May 1888, as previously notified in Public Works Department Notification dated 13th June 1888.

Punjab, August 2, 1888.

Mr. E. S. Bellasis, Executive Engineer, 3rd grade, from the Patiala Division, Sirhind Canal, which he left on the afternoon of the 24th June 1888, to the Karnal Division, Western Jumna Canal, which he joined on the forenoon of the 30th June 1888. Mr. Bellasis took over Executive charge of the Karnal Division, Western Jumna Canal, from Mr. A. B. Phelan, Executive Engineer, on the afternoon of the 3rd July 1888.

Central Provinces, August 4, 1888.

In continuation of Notification of 31st May 1888, Mr. M. Leslie, Executive Engineer, 3rd grade, was granted an extension of one week's privilege leave. Mr. Leslie, Executive Engineer, returned from leave and assumed charge of the Kanhan Division from Mr. G. M. Harriott, Executive Engineer, on the forenoon of the 28th current.

N.-W P. and Oudh, August 4, 1888.

Buildings and Roads Branch.

The services of Mr. G. A. Campbell, Executive Engineer, 3rd grade, on return from privilege leave, are placed at the disposal of



the Railway Branch for employment on the Lucknow-Sitapur Railway.

Railway Branch.

With reference to above Buildings and Roads Branch Notification, Mr. G. A. Campbell, Executive Engineer, 3rd grade, is posted to the Lucknow-Sitapur Railway, *vice* Mr. H. S. Talbot, whose services are to be placed at the disposal of the Gwalior Durbar.

India, August 4, 1888.

Mr. M. J. Monckton, Executive Engineer, 3rd grade, Bengal, is granted special leave for two years under the terms of Public Works Department Resolution, dated 3rd October 1887, with effect from the afternoon of 10th July 1888.

Mr. J. H. Wilson, Superintending Engineer, 2nd class, Bengal, is granted special leave for two years under the terms of Public Works Department, dated 3rd October 1887, in continuation of the furlough for two years granted to him by the Government of Bengal in 1886.

Military Works Department.

The following promotions and reversion in the Engineer Establishment of the Military Works Department, are sanctioned with effect from the dates specified.

Lieutenant W. Huskisson, R.E., from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 11th February 1888.

Lieutenant C. D. Learoyd, R.E., from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 25th February 1888.

Lieutenant A. L. Swainson, R.E., from Assistant Engineer, 2nd grade, sub. *pro tem.*, to Assistant Engineer, 2nd grade, permanent rank, with effect from 26th March 1888.

Lieutenant J. C. Rimington, R.E., from Assistant Engineer, 2nd grade, temporary rank, to Assistant Engineer, 2nd grade, sub. *pro tem.*, with effect from 26th March 1888.

Lieutenant R. F. Allen, R.E., from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 3rd April 1888.

Lieutenant R. F. Allen, R.E. from Executive Engineer, 4th grade, temporary rank, to revert to Assistant Engineer, 1st grade, with effect from 13th April, 1888.

Lieutenant R. F. Allen, R.E., from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 21st April 1888.

Lieutenant H. Mullaly, R.E., from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 25th April 1888.

Lieutenant M. L. Tuke, R.E., from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, permanent rank, with effect from 9th May 1888.

Lieutenant J. R. Gibbon, R.E., from Assistant Engineer, 2nd grade, sub. *pro tem.* to Assistant Engineer, 2nd grade, permanent rank, with effect from 9th May 1888.

Lieutenant W. S. Hunter R.E., from Assistant Engineer, 2nd grade, temporary rank, to Assistant Engineer, 2nd grade, sub. *pro tem.*, with effect from 9th May, 1888.

Lieutenant-Colonel G. D'A. Jackson, General List Cavalry, from Executive Engineer, 2nd grade, to Executive Engineer, 1st grade, permanent rank, with effect from 23rd May 1888.

Captain W. G. Bowyer, R.E., from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, permanent rank, with effect from 23rd May 1888.

Captain T. Digby, R.E., from Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, permanent rank, with effect from 23rd May 1888.

Captain H. Appleton, R.E., from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 23rd May 1888.

Lieutenant E. H. Hemming, R.E., from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 23rd May 1888.

Lieutenant J. R. L. Macdonald, R.E., to be Assistant Engineer, 1st grade, permanent rank, with effect from 23rd May 1888.

Bengal, August 8, 1888.

Mr. J. H. Wilson, Superintending Engineer, has been granted by Her Majesty's Secretary of State for India, special leave for two years, under the terms of Public Works Department, dated 3rd October 1887, in extension of the furlough for two years granted to him in Bengal Government Notification, dated the 18th October 1886.

Mr. P. G. Jacobs, Assistant Engineer, passed the examination in Colloquial Hindustani on the 28th July 1888.

Mr. J. A. Devenish, Assistant Engineer, passed the Departmental Standard Examination in Hindustani on the 28th July 1888.

Mr. G. A. G. Shawe, Executive Engineer of the Circular and Eastern Canals Division, is appointed to officiate as Under-Secretary to the Government of Bengal, in the Public Works Department, during the absence, on deputation, of Major A. D. McArchur, R.E., or until further orders.

Mr. C. Taylor is appointed to officiate as Executive Engineer of the Circular and Eastern Canals Division, *vice* Mr. Shawe. Mr. Taylor joined the Division on the 1st instant.

P. W. D. CHITTAGONG DIVISION.

Tenders are invited for manufacturing and delivering the materials noted below. The Executive Engineer does not bind himself to accept the lowest or any tender.

NAME OF WORK.	Tender to be in Form No.	Amount of earnest money to accompany each tender.	Date and hour of opening tenders.	Date of commencement of delivery.	Date of completion of delivery.	Deposit money required to be paid by the successful tenderer	REMARKS.
Manufacturing and delivering at Chittagong for the Revenue and Judicial Courts and Offices at Fairy Hill. 20 Lacs of Table moulded and Pugged bricks to be delivered at the foot of Fairy Hill on Sites selected by the Executive Engineer.	Supply of (materials.) Form No. 14 P. W. D.	vide table of rates on the form quoted above.	5th September 1888. Wednesday (12 noon.)	Half before the 31st March 1889.	1st September 1889.	Ten per cent on the total value of the supply.	Particulars and specification can be seen— At the office of the Executive Engineer, 1st Calcutta Division. At the office of the Executive Engineer, Dacca Division. At the head office of the Chittagong Division (Chittagong.) Samples of materials required can be seen at Chittagong.

CHITTAGONG ; }  
The 3rd August 1888.

(176)

F. SILLS, C.E.,  
EXECUTIVE ENGINEER,  
Chittagong Division.



Advertisements.

WANTED

A SUB-OVERSEER for the Cawnpore Municipality, must have passed the Boorkee Examination and have some experience. A young, active man will be preferred. Salary Rs. 40 per month, including horse allowance, to begin with.

Applications should reach undersigned before the 15th instant.

By order,  
WILLIAM MOORE,  
Secretary, Municipal Board.

Cawnpore :  
1st August 1888. }

Notice.

TO CONTRACTORS AND OTHERS.

For sale at the S. M. Railway Company Stores at Hubli.

- 10 Portable Engines, 10 H.-P.
- 2 Portable Engines, 12 H.-P.
- Also the following Centrifugal and Contractors' Pumps :—
- 5 eight-inch Centrifugal Pumps, "invincible."
- 4 seven-inch Centrifugal Pumps, "invincible."
- 16 six-inch Centrifugal Pumps, "Invincible."
- 4 four-inch Contractors' Pumps.
- 7 six inch Contractors' Pumps.
- 1 six-and-a-half-inch Contractors' Pump.
- 1 eight-and-a-quarter-inch Contractors' Pump.
- 1 two-and-a-half-inch Contractors' Pump.

The Portable Engines and Pumps have all been in use, but they will be put into working order before being sent away. The Agent and Chief Engineer, S. M. Railway, Dharwar, is prepared to receive offers for any of the above. They are open to inspection to any one wanting them.

Apply to AGENT AND CHIEF ENGINEER.  
S. M. Railway-Dharwar.

FOR SALE AT SIMLA.

TEAK TIMBER thoroughly seasoned, about 4,500 cubic feet, mostly planks, 10-in. by 1½-in. and 5-in. by 1½-in., at Rs. 4-2 per cubic foot.

Deodar Scantlings, 5-in. by 1-in.; 9-in. by 3½-in.; 9-in. by 7-in.; and 8-in. by 4-in., &c., &c., at Rs. 1-3-6 per cubic foot.

Staffordshire Iron Sheets, quite new, 7-ft. by 2-ft. 9-in., at Rs. 10-11-0 per cwt.

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Losses after deducting Re-insurances ...	£443,587 0 0	Claims less Re-insurances, ...	£79,229 0 0	Losses after deducting Re-insurances ...	£138,365 0 0
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General correspondence, and all communications bearing upon literary matters, should, as heretofore, be addressed to PAT. DOYLE, C.E., Spence's Hotel, Calcutta.

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## Obituary.

O'POTTER.—At Palej, on 8th July 1888, from Cholera, J. O'Potter, P. W. Inspector, B., B., & C. I. Railway.

### ANSWERS TO CORRESPONDENTS.

"LIFT PUMP" (Raniganj).—Further correspondence on the subject is unnecessary.

# INDIAN ENGINEERING.

SATURDAY, AUGUST 18, 1888.

## INDIAN RAILWAYS.

**South Indian Railway.**—In comparison with the results of other Indian Railways which we noticed last week, it is pleasant to turn to the working of this line which is much more satisfactory. During the past year its capital account was altered by £170,000, which now stands at £4,300,000, shewing a mileage cost for way and works of £5,648 per mile. The most notable feature in the report is the fact that this Railway has carried, besides season ticket-holders, nearly seven millions of passengers, at an average cost per passenger per mile of less than one farthing. This is a fact which cannot be exhibited in any country in Europe, Asia or Africa. The average fare paid by each third class passenger was 8½d. The percentage of this traffic to the whole is, in the number of passengers 98 per cent., and in receipts from passengers 94 per cent. The net earnings upon the capital for the entire year have been equal to £3 11s. 3d. per cent., as against the cost of the capital, £4 11s. 5d. per cent. During the first six months of 1887 the net earnings were £104,755, which fell short of the guarantee payment upon the whole of the capital by only £67.

**Bengal-Nagpur Railway.**—The accounts for the half-year ending 31st December 1887 shewed a gross revenue (at 1s. 5·247d. per rupee) of £31,805, and an expenditure of £29,223, leaving a profit of £2,582. Length of this line worked was 149 miles, sidings 19½ miles. The ratio of expenditure to receipts was 91·88 per cent. (against 106·66 per cent. in the corresponding half of 1886). The number of passengers carried was 363,350, against 367,540, during the corresponding half of 1886; the quantity of goods carried was 159,248 tons, including 101,447 tons of Railway materials. The whole of the authorised capital £3,000,000, had been created and £2,953,692 received. The expenditure amounted to £1,207,871, of which £859,555 was on lines open for traffic, £239,649 on lines in course of construction, and £108,667 on working stock.

**Southern Mahratta Railway.**—The two important events in connection with this Railway during the past year were the opening of the Braganza Ghât and the taking over of the Bellary-Kistna Railway. The former is 13 miles in length in continuous grade of 1 in 40. There are 14 tunnels on it, besides viaducts, deep cuttings, and high banks. The receipts for the half-year ending 31st December 1887 amounted to £112,342, against £62,494 during the corresponding period of 1886, the expenses to £79,935, against £46,274, and the profit to £32,407, against £16,220. With the extension of the mileage open, the number of passengers and the amount of freight carried increased considerably.

**The Nizam's Guaranteed State Railway.**—The whole of the authorised share capital of £2,000,000 has been issued and received. Of the authorised debenture



issue of £2,000,000 there has been created and paid up £1,000,000, making the total receipts on capital account £3,000,000. The expenditure of capital amounts to £2,661,676, leaving a balance of £338,324. The accounts for the half-year shew a gross revenue of £50,751, against £55,838 for the corresponding half of 1886, while the working expenses were £35,506 against £25,688, leaving a profit of £15,251.

*Bombay, Baroda, and Central India Railway.*—There has been a falling off in the revenue of this Railway, owing to very small exports from the Punjab. But this was not all; there has been another failure of harvest—this time in the North-West Provinces and Rajputana—and the grain, instead of being sent out of the country, was absorbed in it. This will lead to a reduction in the guaranteed interest to the shareholders. The deficiency due to the failure of the crops has been aggravated by the enhancement of the salt duties, and this has told upon the receipts of the Railway, as it is the largest carrier of salt in India. The total revenue for the half-year ending 31st December 1887 was £419,945, against £515,836 during the corresponding period of 1886. The expenditure on revenue account during the same period was, for 1887 £213,409, and for 1886 £242,492. The net earnings, calculated at 1s. 10d. exchange, amounted to £206,541, which is, however, reduced by certain re-adjustments to £206,327. The net earnings of the Rajputana-Malwa Railway (including the Cawnpore-Achnera Railway) amounted to Rs. 30,47,626. In traffic, compared with the corresponding half of 1886, the gross receipts shew a decrease of £95,891, the expenditure a decrease of £29,088, and the net earnings a decrease of £66,803.

*East Indian Railway.*—From a report of the Chairman's address at the last half-yearly meeting of the Company, it would appear that allured by the events of 1883 the Government of India had proposed to them to provide carrying power in the future for the conditions of that year which were unusually favorable, but as Mr. Crawford very properly observed the seasons commanded everything, and it would be idle to adopt a scheme for an expenditure of £20,000,000 a year for ten years, on the supposition that India would always be a grain-exporting country, which it was not. He next observed that the net revenue for the half-year ending 30th June, which, six months ago, was estimated at £1,353,183 had come out at £1,332,902; they were therefore enabled to pay the dividend at the same rate as for the corresponding period of the previous year, viz., 11s. 6d. in addition to the guaranteed interest. In regard to the working of the half-year, the estimated receipts were £2,341,716, compared with £2,364,000 for the June half of 1887, when circumstances were much more favorable, and as compared with £2,367,000 in the corresponding period of 1886. The working expenses were calculated to be £734,708, against £733,030, and £815,000 for the June half-years of 1887 and 1886. It was therefore estimated that they would have a net revenue for the six months ending 30th June last of

£1,607,000 to divide with the Government. But he could not actually say what he could divide, as everything depended upon what the exchange was likely to be up to December next.

We have thus seen that although all the Railways in India have not been so successful as the "East Indian," they have done their best, and it was owing more to a fortuitous combination of circumstances rather than to mismanagement that the results were not so good as had been anticipated. But still there is room for congratulation that the Indian Railways, as a rule, have answered their purpose remarkably well with brighter hopes in the future.

#### FAMINE RELIEF.

IN Israel of old time there were three ordeals provided for the purgation of rulers of men—war, pestilence and famine. Lord Dufferin has run the gauntlet of the first two during his incumbency of office. His successor, it seems likely, more than likely, will be obliged to put forth his energies in a famine campaign, as well as to devote attention to frontier defences, to the defaulting rupee and taxation, to the vagaries of the National Congress, to a hundred dozen minor matters which the outgoing Viceroy will scrupulously refrain from tying his successor's hands by settling. Lord Lansdowne will find quite enough to do in his new office. Amongst other matters, we hope that he will take an interest in (and so be able to find time for consideration of) the grievances of the Uncovenanted Services. Those of members of the Civil Engineering profession in India, not excepted. They are not a few; they have been often complained of; and they are well known. On them we will not discourse to-day. The impending famine is our present concern, and the measures proper to be taken for poor relief and its checkmating. Late rains have, it is true, fallen over most parts of the threatened districts; but very partially, very unequally; too late to do duty as climatic providences, to be depended on to save crops. The season has been an abnormal one from beginning to end—unseasonable, hot beyond all precedent, taking a fiendish delight, it would seem, in falsifying the weather forecasts of the Meteorological Department as soon as they appeared in print. Either meteorology is empirical, not the science it assumes to be; or else its prophets and exponents in India are not up to their business. An unscientific dilemma this, in any case, and not conducive to engenderment or maintenance of popular confidence. The Indian agriculturist is happily, however, not at all disposed to depend on departments; he has rule-of-thumb traditions of his own as to weather forecasts; and they seldom suggest what is not to happen. For some time past he has been prophesying evil things as to weather and crop chances. Now that his prophecies are coming true actually and indeed, mores the pity, it only remains for local authorities to collect statistics and economic facts about the condition and prospects of the various districts, and to concert measures for saving their inhabitants from the pains and perils of famine. In



rural, hand-to-mouth-living India, when there are no crops there is no money. Nor is credit obtainable from mahajans and bunneahs, as in ordinary years. It would be inhuman, a reversion to the dark ages, a wanton dooming of thousands of human beings to destruction to rely upon, carry into practice in such a case, the hard-and-fast dogmas of what Carlyle stigmatized, as "the dismal science." That, ordinarily, supply may be trusted to follow demand is a sound economic rule, and worthy of regard. But—like the rules in the Eton Latin Grammar—it is accompanied by exceptions. Supply will not put itself at a disadvantage to follow demand when demanders have no wherewithal to pay for supplies, neither cash nor credit, goods to barter, or property to hypothecate. Political economy is no more an exact science than meteorology, or marbles. Sir Cecil Beadon's trust in its formalism during the Orissa famine that occurred when he was Lieutenant-Governor of Bengal resulted in something like depopulation in that Province. Times and ideas have changed since then; and Sir Stuart Bayley is not a man likely to be led astray from humanity by sophistries. He was Commissioner of Patna during the Behar Famine of 1874, intimately associated with the relief work then undertaken by Government: he has learnt of experience what to do and what to avoid with regard to the action of the State in such emergencies: he can be trusted equally to avoid the scylla of Sir Cecil Beadon's calamitous *laissez faire*, and the charybdis of Sir Richard Temple's lavish, bombastic extravagance.

We would suggest that the time has come for District Engineers in Bengal to consider how best they may be able, when called upon, to utilize a prospective supply of quasi-elémosynary labour—labour not to be paid for by them, that is to say—on famine relief works in their districts. They should set themselves to determine long before there is any crush of labour likely to invade such works, what roads, bunds, tanks, what other unskilled-labour-employing works their districts are specially in need of; and they should map out schemes and allotments of work for gangs of coolies in different parts of it. There are always, in abeyance or in embryo, lots of local works waiting to be done, upon which it would be well to utilize famine relief labour. By dint of a little pre-vision and arrangement, it might be utilized to the advantage of the community, instead of being frittered away on some inutility or another, some infructuous labour undertaken at the last moment—not because it is intrinsically worth doing, but because it happens to be ready to hand, and because there is immediate need to set applicants for relief at work upon something or other—if only by way of evidence that they are not malingering. It will be well if the nature and scope of that something or other is pre-determined in the District Engineer's mind. His arrangements for carrying his project into practical effect should be there too, cut and dried in embryo. Then, when the time of emergency comes, when thought and plan have to give place to prompt action, he will be in a position to meet events, to order and arrange his

famine campaign in workmanlike fashion, as it should be ordered and arranged, efficiently and economically.

In famine times, more than half the muddles, the shortcomings, the failures, one hears about are occasioned by want of preparedness, absence of a definite plan of campaign. Fads are to be avoided. A contemporary calls attention to one of Mr. Meredith Townsend's *apropos* of famine: "Sink," said he, "a well in every *talug*. There is plenty of water in the subsoil; the cattle can, night and morning, get all they want, while *la petite culture* can be carried on." We take it that in every Indian *talug* there are dozens of wells; but what is the use of them if they contain no water, if, as frequently happens, the subsoil contains none either.

We concur with Mr. Townsend's critic when he writes:—"Considering that an Indian *talug* is as large as an average English county or larger, I was not impressed with the brilliancy of the suggestion."

#### SIR ALFRED LYALL'S GOVERNANCE.

WE have before us the N.-W. P. and Oudh Administration Report for 1886-87, and gather from it that the total yearly expenditure under the Public Works Department for buildings and roads amounted to Rs. 55,60,232—somewhat less than the budget grant, which was Rs. 56,48,800. The Thomason Engineering College cost Rs. 1,80,391. Grants at district disposal are reported to have been "well and fully utilized." The main expenditure under local agency was incurred on the construction and maintenance of district communications. This is as it should be. The only noticeable feature in the year's work was completion of the military cart-road between Ranibagh, the terminus of the Rohilkhund-Kumaun Railway, and the hill cantonment at Ranikhet. The only work of importance left unfinished when the Report was written being the bridge over the Kosi at Ramgach. The Husainabad clock tower at Lucknow was completed during the year. It cost Rs. 16,300.

About local railways, we are informed that under the head of capital construction the only work of importance in progress was the Lucknow, Sitapur, and Seramau line, on which a total outlay of sixteen lakhs of rupees was incurred, work having been pushed on very vigorously throughout the year. The section from Lucknow to Sitapur, 55 miles long, was finished, and afterwards a further length of 28 miles to Lakhimpur. The bridge over the Jumna at Kalpi was completed in October 1887. So was the Pilibhit-Seramau railway section connecting branches from Bareilly and Lucknow. An association having it in view to construct a line from Hurdwar to Rajpur, at the foot of the Mussoorie hills, a Government Officer was, at its request, deputed to report on the project. The report was favourable, and the alignment selected has been marked out by masonry pillars. We hope that the promoters are not going to rest satisfied with this achievement, but that they will carry on the original plan. There can be no doubt that a railway to Mussoorie would be an immense advantage to the



Indian public at large; carefully calculated estimates from more than one source have shewn the likelihood of such a line being a paying one. The working of the Cawnpore-Achneyra line was transferred to the Bombay, Baroda and Central India Company during the year under review—a contribution to centralization to be commended. The local Government has now no railways under its direct control.

Of the outlay on canals a modicum of Rs. 13,00,000 was spent in connection with the Nadrai aqueduct. The balance of expenditure—say Rs. 6,00,000—was chiefly incurred for completion and extension of distributary and drainage systems. The actual length of new channel brought into use was 233 miles. The heavy rainfall of the year told however against canal receipts: the area irrigated and revenue assessed shewing a decrease of 345,861 acres and of Rs. 8,92,034 respectively. A year of agricultural prosperity, however well inclined, cannot benefit everybody. Departments must needs suffer sometimes for the public good. Excluding the Betwa Canal, petted as a "protective work," the return from canals is set down at 3.60 per cent., as against 4.95 per cent. in the previous year. Canal Establishment charges shew a decrease of Rs. 75,000, due partly to a reduction in the actual number of officers employed.

We note that the Survey Department provided every village with a cadastral map on the scale of 16 inches to a mile. Also with correct field maps, and rent-rolls. It is a pity, but it is a characteristic fact, that the ryots' indigenous love of litigation so over-powered all other sense in them that they were far from grateful for these favors. Their rent suits in the local courts cost from first to last, we are told, no less a sum than Rs. 26,49,184. The new system for payment of land revenue by money orders is said to have worked well and to have proved a considerable convenience to landowners. It is refreshing to hear that considerable reduction has been made in the cost of printing forms for village records and statistics, and we are glad to hear of an "improved" system for the annual correction of village maps. Any fad is better than abstruse lethargy.

An impetus was given to the employment by private persons of the apparatus introduced by the Agricultural Department for making trial well borings: efforts were made to popularize "improved dredgers:" apprentices trained at Cawnpore were sent to demonstrate ocularly, in the villages of seven districts, the merits of the "improved" ploughs which are made in the workshops attached to the model farm there—with what result is not apparent. Nearly 350 miles of road were planted with avenues and expenditure on arboriculture was reduced by measures for enhancement of receipts from lopping and felling. A growing interest in the operations of the Department is held to have been evinced by landowners. The services of Mr. Duthie, Superintendent of the Botanical Gardens at Saharunpore, having been requisitioned by the Government of India, he was succeeded by Mr. Gollan.

The administration of forests is characterized as "particularly successful." The money surplus earned by the

Department rose to six and a half lakhs of rupees—a handsome contribution to provincial revenues. But we do not find anything written about improved pay and prospects for overworked, much enduring officers of the Department. Under their direction, timber to the amount of five million cubic feet, fuel to the amount of six and a half million cubic feet, and minor produce to the value of four lakhs of rupees were removed from the forests during the year. The outturn of wood for sale came to five and a half million cubic feet of the more valuable sorts, and realized the unprecedented sum of 15½ lakhs of rupees, while expenditure was at the same time lessened. We doubt whether any Indian Department of any sort or description has ever been able to shew such splendid results, even opium not excluded, if due regard is paid to those circumstances that alter the condition of cases.

Schemes for water-supply to Allahabad, Agra, Lucknow and Benares have been under consideration, but financial pressures have opposed their consummation. Seven new medical dispensaries have been opened, and are doing work useful and humanitarian. The number of female pupils at the Agra Medical School is increasing. There were fewer lunatics than usual in the Asylums. Manifestly, Sir Alfred Lyall's rule in the North-Western Provinces and Oudh was eminently successful. The lowest plains temperature in the shade during his reign was 34.1° observed at Ajmir on the 28th and 29th of January. On the 25th May the thermometer rose, at Agra to 115.6, at Jeypore to 115.8. Atmospheric pressure was, on the whole, slightly above normality, but with the exception of Jhansi, the observations for which place are admittedly somewhat doubtful, departure from the mean average did not much exceed a twenty-fifth of an inch at any time. The most noticeable departures from normal wind direction occurred in October, when at nearly every station in the plains the resultant was easterly instead of westerly. About the middle of June a cyclonic storm travelled from the coast of Orissa to Sir Alfred Lyall's dominions, and was tracked as far as Sialkot. It was a blessing; a harbinger of the setting in of the rainy season. All things were blessed to Sir Alfred Lyall. The very forces of nature fought on his behalf. *Beatus ille*. For inferiorly constituted humanity it only remains to wonder and admire.

A GREAT SIBERIAN RAILWAY.—A Railway through Central Asia to Peking is the latest Russian project. It will probably be a long time before the terminus at Peking is reached, but a Railway through the whole length of Siberia, with its eastern terminus in the Primorsk, or coast province on the Pacific, is a plan which will be certainly carried into effect within the next few years. This will enable Russia to do easily what she could now only attempt with great loss of time and treasure—namely, to move an effective force to the northern frontiers of China. Once this line is made, a branch to Peking will be no very difficult matter. Russian influence has been on the wane in China for many years. The growth of the Russian naval power in the Pacific, and this Siberian Railway project will help to revive it.

SAD CALAMITY AT VALPARAISO.—Advices received from Chili state that a great calamity occurred at Valparaiso. A reservoir there has burst, destroying one hundred horses and engulfing hundreds of souls.



## Notes and Comments.

**BURMA P. W. D. CHANGES.**—Mr. E. W. Oates, Executive Engineer, Rangoon Division, leaves on furlough shortly, and Mr. Hoyne Fox, Executive Engineer, takes charge of his Division.

**DARJEELING-HIMALAYAN RAILWAY.**—A dividend of 5 per cent. is payable to the shareholders of the Darjeeling-Himalayan Railway on account of the profits for the first half of this year.

**RAILWAY EXTENSION IN BURMA.**—The Government of India has sanctioned Rs. 1,28,028 for the survey of a line of Railway up the Mu Valley as far as Kyundawgyi, 128 miles, and a reconnaissance thence to Mogoung, 168 miles, with a branch of 80 miles from Manle to Bhamo.

**"SONTHALIA."**—The recent memorial to the Lieutenant-Governor at Deoghur, relating to the extension of the Deoghur Steam Tramway to Rampore Haut *via* Doomka, deals with matters already fully set forth in this Journal by Mr. Agabeg Agabeg in our issue of the 17th March last.

**THE INDIAN PATENT STONE COMPANY.**—This concern has been registered, with a capital of Rs. 57,000, to acquire certain patent rights of Messrs. W. and E. Garlick in an artificial stone. The Managing Agents are Messrs. Bird and Co., who are to hold shares to the value of Rs. 5,000 in the undertaking.

**ELECTRIC LIGHTING IN BURMA.**—In reply to a proposition of Messrs. Gillanders, Arbuthnot & Co., the Agents of the Orient Electric Light Company, Limited, to light the town with electric lights, the Rangoon Municipality say that they are not in a position to consider such a scheme at the present time.

**MR. GEORGE ANDERSON.**—We are glad to learn of the safe return of Mr. George Anderson, District Board Engineer of Malabar, after an extended tour through Europe and America, where Mr. Anderson had opportunities for obtaining some valuable information relative to his own speciality—Iron Bridges.

**THE MAYO SCHOOL OF INDUSTRIAL ART, LAHORE.**—The development of this institution has been so rapid of late years, and the demand on Mr. Kipling's time so heavy, that the Punjab Government has found it necessary to ask the Supreme Government for the services of a Vice-Principal on a salary of Rs. 400 a month.

**RAILWAY BRANCH, BENGAL P. W. D. SECRETARIAT.**—We learn that Mr. F. B. Hebbert, Under-Secretary in the Railway Branch in the Bengal Secretariat, has been deputed to Simla on special duty, and that Mr. T. E. Owen, an Executive Engineer 1st grade, recently attached to the Burma State Railways, will officiate for him.

**THE PITY OF IT!**—Mr. F. N. Thorowgood, late Superintendent of the Madras Harbour, left Bombay for England on the 6th instant. It is a great pity that circumstances, over which he had no control, did not admit of his bringing to a completion the great undertaking with which he was conspicuously identified for twelve years.

**NEW HIGH COURT BUILDINGS, MADRAS.**—The cost of the new High Court buildings, Madras, on the Lighthouse, Esplanade, is roughly estimated at ten lakhs of rupees. The plans, when completed, will be submitted to the Government of India for approval and sanction. We hope to give further particulars and a site plan in our next issue.

**OBITUARY.**—We regret to hear of the death of Lieutenant Harvey R.E., in the Kojak Pass on the 10th instant. Lieutenant Harvey was a most promising young officer and had been engaged during the past year in constructing a military road over the Kojak pass. This road has a ruling gradient of 1 in 25 and is a fine work reflecting much credit on those engaged on it.

**THE BOLAN RAILWAY.**—Quetta has at last had rain which was much wanted but not nearly the amount due. Rain has fallen heavily in the Bolan Pass and breached the temporary railway in many places. It is a pity Government will not make up its mind to construct the line on a permanent formation once for all and avoid the heavy annual expenditure for repairs.

**A SUCCESSFUL INDIAN AT COOPER'S HILL.**—We are glad to learn that Mr. Preonath Sen is one of the successful candidates passed out at the recent final examination of the Indian Engineering College at Cooper's Hill. Mr. Sen stands twelfth on the appointment list. He is the eldest son of Mr. Rajkrishna Sen, late fourth Judge of the Calcutta Small Cause Court.

**SIR STEUART BAYLEY'S TOUR.**—We hear that Mr. E. J. Martin, the Chief Engineer of Bengal, will accompany the Lieutenant-Governor during his tour in Eastern Bengal, and will afterwards proceed to Darjeeling, not returning to Calcutta till November. His Honor is to be congratulated upon numbering among his advisers one with the knowledge and experience of the province possessed by Mr. Martin.

**COMPETITION ON THE IRRRAWADDY.**—There has at last been an attempt to start competing steamers on the Irrawaddy, but as yet it is only by a few steam launches. They were put on the run between Rangoon and Yandoon. The result pretty plainly proves that other river steamers plying between Rangoon, Mandalay and Bhamo would be a *desideratum*—a great advantage to the public and the Government.

**BENGAL P. W. D.**—Mr. W. B. Bestic, Under-Secretary to the Government of Bengal, in the Public Works Department, is granted privilege leave for two months and nine days. Mr. W. Connan, Inspector of Local Works in the Presidency Division, is appointed to officiate as Under-Secretary. Mr. W. H. Nightingale, Officiating Superintending Engineer of the Eastern Circle, is appointed to act also for Mr. Connan.

**THE P. W. D. ADMINISTRATION OF TRAVANCORE.**—The Madras Government, in reviewing the administration report of the Travancore State for the year 1062 (August 1886 to August 1887) of the Malaiyalam era, says that no special remarks are required in regard to the public works of the year. The expenditure amounted to six lakhs and a half, the bulk of which was on roads and buildings. The establishment for carrying them out cost Rs. 89,000 or 13·7 per cent.

**BOMBAY UNIVERSITY.**—The subject selected by the Syndicate for the Sir George Le Grand Jacob Prize Essay of 1889 is as follows:—"The Introduction and Development of the Indian Railway and Telegraph Systems and their Influence on the Social and Economical Conditions of India." The subject selected by the Syndicate for the Ashburner Prize Essay of 1889 is as follows:—"New Manufactures which might be advantageously introduced into India."

**FLOODS IN THE BANDA DISTRICT.**—There have been very heavy rains in the Banda District. The river Keu



rose very high, and a part of the city called Nimnipore was submerged. A large number of *kutchas* houses, chiefly inhabited by poor people, fell in, the wells and tanks overflowed, and roads were washed away. The Indian Midland Railway works suffered considerably. The river Bayhin also rose, and did much injury to the town of Badausa and the Railway works there.

**BURRAKUR WATER-LIFTS.**—We learn that the Bengal Iron-Works are doing a large business in these "Lifts" now. They are mostly sold to natives. There is nothing in the lift that can get out of order, as no wood, leather, or Indian-rubber is employed on them. They are made entirely of iron, and consequently there is no religious prejudice from natives against them. One of these "Lifts" has been at work for 18 months, every day for 8 hours, and does not require any repairs as yet.

**PRIZES FOR TORNADO STUDIES.**—The *American Meteorological Journal*, recognizing the high importance of a fuller knowledge of tornadoes, and believing that a combined effort will much advance our present knowledge of the subject, offer for general competition the following prizes:—A prize of \$200.00 for the best original unpublished essay. A prize of \$50.00 for the second best. The sum of \$50.00 to be divided among the writers of the remaining essays which are considered worthy of especial mention.

**SEEBPORE ENGINEERING COLLEGE.**—The final examination of the Mechanical 4th year Class was completed before the College closed on the 11th instant. We learn that 18 out of 21 apprentices passed—2 in the 1st Division, 13 in the 2nd, and 3 in the 3rd. At the recent University Examination, 10 students of the "Civil" Class went up for the "L. E.," of whom 5 passed—Martindale standing first, and thereby getting the guaranteed appointment. He has been posted as an Engineer Apprentice to Ranchee.

**JOBBERY DEFEATED!**—The recent ridiculous attempt to throw away some thousands of rupees of public money by the State Railway Department calling for public tenders for 300 logs of teak timber, of which the Government hold some thousands of logs, has been frustrated. The *Rangoon Times* holds that the officer who sanctioned the advertising for tenders of what he must have well known the Government held large supplies, should pay for the advertisement. Are not the State lines in Burma under Provincial Control?

**THE NEW R. C. CHURCH AT SIMLA.**—The only large building now in course of construction in Simla is the new Roman Catholic Church, which promises to be another admirable specimen of Mr. Irwin's skill as an architect. The Church will cost very nearly Rs. 70,000, without any interior fittings or furniture. Of this, Rs. 40,000 have been collected from local sources. Where the remainder is to come from no one can yet say, but the Roman Catholic Church in India is never at a loss for ways and means, as the new buildings in Allahabad clearly prove.

**VICTORIA JUBILEE TECHNICAL INSTITUTE.**—The Victoria Jubilee Technical Institute, Sessions 1888-89, will open on the 12th November next. The Institution will at present give instructions in machine drawing, in steam, in mechanics, theoretical and applied, in physics, i.e., electricity and magnetism, sound, light and heat. The workshop will be begun some time in the beginning of next year. The Institute has applied to Government for power to grant certificates of competency under the Boiler

Inspection Act, and it is believed that Government will accede to this request.

**RESULT OF THE DECCAN MINING CONCESSION ENQUIRY.**—The official report of the Select Committee is defective and disappointing. It considers that there was no deficiency in the remuneration which had been given to the concessionaires for previous services that entitled them to the mining concession. The concessionaires used the concession for the realization of great gains which were not intended for them, and this was done to the injury of the Nizam's State with the assistance of Abdul Huq. In conclusion, the report deprecates direct communications between Native States and speculators.

**ALIPORE COAL COMPANY.**—The report of the Managing Agents for the half-year ended 31st May discloses, after payment of debenture interest and the usual depreciation on plant, &c., a loss on the working of Rs. 485, and the credit balance at Profit and Loss is reduced to Rs. 72. The total quantity of coal sold and delivered was 28,500 tons, against 23,200 tons for the same period of last year. There is a large stock of raised coal at the mine which the Agents say has been valued over at low rates, and which when sold (which they hope to do soon) will shew the profit that should otherwise appear in this half-year.

**GOOD FROM EVIL.**—One good result has already followed from the Hyderabad mining scandals. The House of Lords has passed what is known as the "Companies Bill," a Bill intended to secure the community against the frequent rascalities which have grown out of the Limited Liability Act; and when the House of Lords' measure reaches the Commons next Session, Mr. Chamberlain will move for the appointment of a Royal Commission to consider the existing Acts. The question is second to none in national importance, and in the present state of the House of Commons this is the best way to begin to deal with it.

**"BENGAL COAL" FOR BURMA.**—The *Rangoon Gazette*, in noticing the arrival of the British India Steamer *Byculla* with a full cargo of some 2,000 tons of Bengal coal shipped at Calcutta for the Irrawaddy Flotilla Co., says that "this is the first instance, we think, of Bengal coal being imported here and in large quantities, although we have learned that lately the Local Government has been receiving supplies from the same quarter." Our contemporary is at fault. We recollect trial shipments of Bengal coal being made to both Rangoon and Madras in 1885, with a view to introducing the Indian mineral in those parts of the country. The item of *freight* proved the adverse factor.

**THE EASTERN BENGAL RAILWAY SYSTEM.**—In giving an account of the recent accident to the up Darjeeling mail train on the Northern Bengal State Railway, the *Darjeeling News* says: "The Railway authorities rendered no help to the unfortunate passengers in carrying their things from one train to the other. No coolies could be got, neither were any arrangements made by the Railway officials in removing their luggage." This can only be due to bad management. Traffic was also interrupted the other day on the Dacca Railway, owing to the sinking of a small culvert. The state of the culvert was discovered in time, so that there was no accident. Of course the traffic was delayed, passengers having to be "transhipped."

**PORT CANNING ARTESIAN BORING.**—We glean from the last Report of the Company that the well experiment reported last year is still in progress. This experiment would have long since come to an end, but the Engineer



who was in charge of the work fell ill repeatedly, and subsequently left the service. The work is now carried on under the Agent's supervision, and with the aid of a steam engine. The pipe has gone more than 300 feet deep, and a spring of good drinkable water has been tapped. What is necessary, however, is a spontaneous and free overflow of water, which is at present much impeded by sand. It is expected that when the pipe goes lower and passes the sandy strata, the water will have no obstruction, and will then freely overflow.

**PRIVILEGE LEAVE IN THE MILITARY WORKS BRANCH.**—The privilege leave permissible to officers belonging or attached to the Military Works Department, will be granted by the General Officers commanding the Divisions or Districts in which the officers concerned are serving, on the application of their Superintending Engineers. Privilege leave to Superintending Engineers, and the leave allowed under existing Regulations to enable officers in the Military Works Department to pass in the native languages, or to qualify for regimental promotion, will be granted, under the orders of the Commander-in-Chief, on the application of the Inspector-General of Military Works. Leave granted under these rules will not be notified in General Orders.

**BURRAKUR COAL COMPANY.**—The report of the Managing Agents for the year ended 31st May discloses a profit, after setting aside the usual amounts for depreciation, of Rs. 34,875; and adding the balance from the previous half-year, the amount at credit of Profit and Loss is Rs. 40,205. An *ad interim* dividend of 15 per cent. has already exhausted Rs. 22,500, and it is now proposed to declare a final dividend of 10 per cent., or Rs. 15,000, and to carry Rs. 2,705 forward. Twenty-five per cent. per annum is probably the largest dividend ever declared of late by any concern in Bengal. The quantity of coal and coke sold and delivered during the year amounted to 43,856 tons, against 43,593 tons during the previous year. The machinery, colliery and buildings are said to be in good order.

**RAILWAYS IN CHUTIA-NAGPUR.**—We glean from the Resolution on last Administration Report of Chutia-Nagpur that progress is being made in the acquisition of land for the Bengal-Nagpur Railway Company. There was some hesitation in determining the point of junction with the East Indian Railway line, and the Asansol route was not finally selected till last cold weather. Station sites have now been selected, and every effort is being made to have the rails laid as far as Purulia by the 1st January 1889. The Benares-Cuttack line, which, according to the plans approved by Government, will intersect the Bengal-Nagpur line at Purulia, has not yet been taken in hand. It is difficult, as Mr. Stevens observes, to over-estimate the effect which these two lines will have in developing the resources of the division.

**PERIYAR PROJECT WORKS.**—The necessity of always having a margin to the establishment, so that outside work (i.e., projects not ordinarily provided for) can always be taken up, is apparent from the fact that in consequence of the abnormal drain made upon the Madras P. W. executive, on account of the number of hands required in connection with the Periyar Project, the Government of India have sent down two Executive Engineers, Messrs. Clift and Davies, and one Assistant Engineer, Mr. Phillips, for temporary employment under the Madras Government. In connection with this work the Secretary of State, upon the recommendation of Colonel

Pennycuik, R.E., the officer in charge, who, while in England, on deputation, selected a man, has sent out Mr. B. J. Mathews, as Mechanical Engineer for conducting tunnelling and boring operations.

**A GOOD RECORD FROM THE NIZAM'S DOMINIONS.**—The Engineering works in connection with the Irrigation Board in the Telingana districts are making very fair progress. For Indore, estimates for 47 projects were prepared, and of these 24 have been sanctioned. All of these works are in course of execution, and it is expected that about 1½ lakh will be expended in this district within the year. In Yelgundal four projects have been completed, and work has been begun on twenty-one plans in anticipation of sanction, while for thirteen estimates, sanction is still awaited. It is thought that the expenditure in this district will be about Rs. 40,000 or Rs. 50,000 by the end of the year. In the Medak district likewise very important works have been proposed, and in fifteen instances estimates have been submitted, but the works have not yet been sanctioned.

**ITEMS FROM SIMLA.**—One of our Correspondents writes:—The retaining walls of the new Government House, Simla, have, it is said, given way under the constant heavy rains. It is unfortunate that they were not constructed of solid masonry, which, however, could not be done on account of the estimates being reduced by the Punjab Government. Where 13 lakhs could be sanctioned to erect the building, surely a few thousands more might have been allowed for its security. The Town Hall, in spite of recent repairs, "pointing," asphaltting and finishing off of masonry, is leaking to a shameful extent. The walls are all stained and dripping, and pools of water are lying on the floors in the library, reading rooms, and various other parts. It is to be hoped that the place may be rendered water-tight at least, before the recent grant is wholly expended.

**REDUCTIONS IN THE P. W. D.**—Recent decisions of the Government of India as regards the Bengal Police have set that Department in a ferment: and we learn that each Department will be attacked in turn, but the "coup" will fall upon the P. W. D. This Department, since the departure of Sir Theodore Hope, has at its head one who was well-known as an antagonist to the Public Works policy before he ever dreamt of high office as its representative, and in several of his actions Sir Charles Elliot does not shew that sympathy and watchfulness for his charge that ought to be his first duty. His aim seems to be to follow up the "cheese-paring" policy which is now associated with his name—but what faith can be placed in the honesty of his intentions when jobbery, such as we have lately exposed in the matter of a rival journal, can be perpetrated by one to whom the great Public Works of India has to turn for guidance.

**THE NEW DRY DOCK.**—The *Bombay Gazette* writes:—Reuter tells us in his not unusual tantalizingly incomplete way, that the proposal for a dry dock at Bombay is included in the report of the Committee on the Naval Estimates. Seeing that at least three plans—Sir John Coode's, with an estimated outlay of £300,000 to begin with, and a lakh or two a year for dredging; Captain Hext's and Mr. Ormiston's, which would cost half that sum; and the modest little scheme for enlarging Duncan Dock at a cost of five lakhs—have been under consideration at the Admiralty and the India Office, the information might have been a little more explicit. But the telegram by implication tells us one important thing. The fact



that the item is included in the Navy Estimates shews that the Home Government will make a contribution to the cost of the new dock. There remains to be answered the two questions "which scheme?" and "how much will the Home Government contribute?"

**THE EASTERN TELEGRAPH COMPANY.**—By the report of the Directors of the Eastern Telegraph Company, it appears that the revenue for the six months ended 31st March last, was £359,706, from which are deducted £87,134 for the ordinary expenses, and £38,412 for expenditure relating to repairs, renewals, and laying of cables, &c., during the half-year. After providing £4,452 for income-tax, there remains a balance of £229,707, to which is added £29,397 brought from the preceding half-year, making a total available balance of £259,104. From this balance there has been paid—interest on debentures and debenture stock £29,835; dividend on preference shares, £20,384; and an interim dividend of  $1\frac{1}{2}$  per cent. on the ordinary shares, £47,500; leaving a balance of £161,384, from which £75,000 has been carried to general reserve. The balance dividend now to be paid will bring the total distribution up to 12s. per share, or 6 per cent. for the year on the ordinary shares; and this will leave £884 to be carried forward.

**MERIT LEADING TO DISTINCTION.**—Mr. R. Proctor Sims, C.E., has been appointed member of the Council of the Bhowuggur State in Kattywar. This is the first instance of a European gentleman being placed on a Council of a Native State, and of the appointment at the same time carrying such popular feeling with it. Mr. Proctor Sims, like Mr. R. F. Chisholm and Mr. Stevens, was a Government Engineer originally, who did better without red-tape. Mr. Sims has been State Engineer at Bhowuggur for many years, and in that capacity has done much useful work. He is now Minister for Public Works, head of the Municipality, Superintendent of Horse-breeding Operations, Superintending and Executive Engineer, Justice of the Peace, General English Secretary, and everything else of public utility to the State. It is said that the natives love him as a friend and adjudicator, while the Chief of Bhowuggur respects him as a father. The Profession in India are under an obligation to Mr. Proctor Sims as the founder and editor of the late *Bombay Builder*.

**BOMBAY WATER SUPPLY.**—The matter of the leakage of the Malabar Hill Reservoir has been gravely, deliberately, secretarially, considered in Council; and the conclusion come to is that "leaks have been found in a few places." The remedy proposed is expenditure of Rs. 1,500 "in pointing this portion (these portions) to a depth of six feet below the top of the old walls of the settling basin." Then it is laid down as an axiom that the proper rate for filtration is 4" per hour; and it is held that, in order to the adequate filtration of five million gallons of water, per diem, there ought to be made and provided, at least 117,000 square feet of sand. Whereas the existent filtering area is but 49,000 square feet! What even such mediocrities as Lord Ripon, and Mr. Ilbert—if they had had eyes to see a span's breadth beyond their party prejudices—would have been able to recognize as anomalies. 68,000 square feet of additional area, and certain subsidiary arrangements—*vide* a sludge pipe, a ladder, and an "overflow"—are requisitioned by the men who propose to mend the Malabar Hills Tank. They don't seem to have much confidence in themselves. *Mais Dieu dispose.*

**ROYAL INDIAN ENGINEERING COLLEGE.**—The seventeenth session of the Royal Indian Engineering College Cooper's Hill, was brought to a close on the 25th July, by the annual distribution of prizes, the ceremony being performed by Sir J. Fowler, past President of the Institution of Civil Engineers. Sir A. Taylor stated that the report for the year was most satisfactory. During the past five years the college had grown a great deal, the number of students had in the same period increased from 90 to 139. They were also teaching more subjects than they had dealt with hitherto. Then, again, they had extended financially, their year's income fully covering their year's outlay. The prizes were then distributed, and the three principal students—F. Clayton, E. A. S. Bell, and C. E. Dupuis—were appointed Fellows of the College. Sir John Fowler in his address to the students explained his connection with the College. He was, he said, almost responsible for its existence. It was by his advice that the Government had abandoned the idea of closing the College altogether, and had opened its doors more widely so as to admit a larger number of students, to the best of whom appointments in India would be given as prizes. He was satisfied that the experiment had been successful.

**A CREDITABLE PERFORMANCE.**—The work entrusted by Government to Messrs. Scott, McKenzie and Co., Engineers and Contractors, of erecting at Kotri a little fleet of four steamers and eight barges for the Sind-Sagar Railway, has progressed so far that the vessels are expected shortly to proceed up the Indus to their destination at Sher Shah, Dhera Ghazi Khan, and Dhera Ismail Khan where it is intended that they shall be employed for ferry purposes in connection with the Sind-Sagar line. Both steamers and barges were built by Laird Brothers, of Birkenhead, and they have been put together by Messrs. McKenzie and Co. in the floating dock, which was imported some years ago by the defunct Indus Steam Flotilla Company. The steamers—which are of galvanized steel, as are also the barges—measure 165' by 30' by 5', and draw, when loaded, 2' 6", the dimensions of the barges being 80' by 16', with a draught of 1' 6" when loaded. The vessels have been tested by a committee of experts, who have pronounced them to be perfectly satisfactory with respect to speed, draught, &c., but have declared them to be wanting in certain minor details of design with regard to passenger accommodation, which are now being supplied by the Contractors, whose despatch in erecting four steamers in as many months is worthy of note, as it is highly creditable to the enterprise of this comparatively young firm.

**THE GOVERNMENT OF INDIA *VERSUS* INDIAN ENGINEERING.**—The *Indian Daily News* writes:—"When it was stated some time ago that the Government had given its patronage or support to a professional paper, we anticipated that universal satisfaction would not be one of the results. As might have been anticipated, the conductor of a competing paper does not think this fair treatment, and accordingly addressed the Government on the subject. First he addressed Sir Charles Elliot, Minister of Public Works, asking for 'fair play.' This does not mean an equal subsidy, or whatever be the form of support given, but simply that the competing papers should be severely let alone. Sir Charles Elliot did not reply to this letter, and the proprietor of the aggrieved journal addressed the Viceroy on the subject, asking His Excellency whether the P. W. D. is justified in lending a helping



hand in such a case. 'I ask no favor, but that the two journals may be left to fight their own battles, and leave the issue of the survival of the fittest to the course of events.' The reply to this letter does not appear to have been satisfactory, inasmuch as it is followed by a memorial to the Secretary of State for India that contains a critical phrase and a comment which are submitted for the consideration of the right honorable gentleman. It is a pity that such subjects should have to be referred to the Indian Office; and certainly a matter of regret that there should be anything done to give occasion for such a reference." The matter may not end there. Awkward questions on less important subjects have been asked in the House. It has recently transpired that Sir Charles Elliot induced the Viceroy to accede to his wishes even after the Finance Department had vetoed his proposal. The motives which dictated the action of the Minister for Public Works are questionable—particularly when he wishes to be known as an advocate "for a less expensive administration," and goes so far as starving public works on the score of economy.

**COST OF PUBLIC BUILDINGS IN THE CITY OF PALACES.**—In England every architect knows from experience, and it has also been verified by actual calculation, that a certain rate per foot cube may be taken in order to ascertain the probable cost of buildings of different kinds. It is a great saving of time and trouble to be able to arrive at such an estimate at an early stage of a design, so as, if necessary, to alter it before too much labor has been spent upon it, and to go over the whole ground again is very discouraging and demoralizing to the architect. But the information as to the rates per foot cube or super should be accurate, and the class of structure should be well-defined. The practice in India, as far as it exists, is to work upon a basis of superficial feet, and the results, if carefully worked out, ought to prove reliable. The following notes as to the cost per superficial foot of several important buildings in Calcutta might prove interesting:—

	Rs.	As.	P.
High Court (3 storied) ...	18	6	0
Small Cause Court (3 storied) ...	17	9	0
Sealdah S. C. Court (2 storied) ...	...	...	...
Calcutta University (1 storied) ...	11	12	0
Presidency College (3 storied) ...	15	10	0
Hare School (2 storied) ...	9	0	0
Madrisa (1 storied) ...	10	10	0
General Post Office (2 storied) ...	11	0	0
Telegraph Office (3 storied) ...	17	12	0
New Financial Buildings (3 storied) ...	18	15	0
New Central Press (3 storied) ...	15	4	0
Military Accounts Offices (3 storied) ...	16	1	0
Writers' Buildings, new wings (3 storied) 14-10-0 to 15-12-0	...	...	...
Imperial Museum (2 storied) ...	20	11	0
Museum Annexe (1 storied) ...	11	0	0
St. Andrew's Church (2 storied) ...	10	0	0
St. James' Church (2 storied) ...	18	0	0
Choonee Lall Seal's Dispensary (1 storied) ...	2	10	0

In noticing these rates, it may be useful to state that it is found that the following information may be worked upon in the case of first-class work with flat terrace on iron beams, and with stone or tiled floors.

	Per ft. super.	Rs.	As.	P.
Dwelling House, single storied, 18ft. high on 4ft. plinth ...	...	5	0	0
Do. Do. double storied ...	...	9	0	0
Do. Do. three storied ...	...	14	0	0
Out-offices ...	...	3	0	0

One-third—extra should be allowed on these rates in the case of important buildings with ornamental façades.

## Current News.

SIR CHARLES ELLIOT opens the Fine Arts Exhibition at Simla on the 29th instant.

CAPTAIN A. HEATHCOTE, R.E., is posted as an attached officer to the Rawal Pindi Command, Military Works.

CAPTAIN H. APPLETON, R.E., Quetta, will be transferred to Mooltan on relief by Major R. F. Moore, R.E.

THE construction of barracks at Landi Kotal is now being actively taken up. The first barracks will be of iron.

ANOTHER accident is reported from Kalinagar in the Hidgellee canal as having occurred on the 31st July. No lives were lost.

FLOODS up-country are reported to have destroyed a bridge on a part of the Burma Railway Extension line not yet opened to traffic between Pyinmana and Yemethen.

THE Bengal Government intends carrying out a reconnaissance next cold season in the country between Gya and Ranaghat with a view to the extension of the Provincial Railway System.

CAPTAIN J. M. BECK, of the Indian Marine, who so successfully accomplished the Hog Island works at Bombay, is now engaged specially to complete the harbour works of Bhownugger.

THE Master of the Mint, Calcutta, and the Assay Master are appointed a Committee to report upon the questions connected with standard weights and balances of precision in the Indian mints.

NEWS has been received from Gujarat that there was a slight rainfall up to Bulsar only, but the outlook in the country north of that station still continues more alarming than during last week.

A SURVEY party headed by Babu Kali Prossono Majumdar, Sub-Engineer, Military Works, has just returned from Diamond Harbour, where the Chingree Khall battery will be constructed, that site having been selected.

MR. A. S. JAMESON, District Locomotive and Carriage Superintendent, North-West Railway, Lahore, has been appointed to officiate as Locomotive Superintendent, Eastern Bengal State Railway, *vice* Mr. H. T. Ferguson, resigned.

LIEUTENANTS MACDONALD and Pringle, R.E., have gone to Landi Kotal in the Khyber to commence work again upon the fortified *serai* at that post. Lieutenant-Colonel Warburton, Political Officer in charge of the Khyber, accompanied them.

A SUBSCRIPTION list has been started for the purpose of completing the work of enlarging the Cathedral at Mutwal, Colombo. It is hoped this will be accomplished before the return of the Bishop. The first cost of the work is put down at Rs. 10,000.

MR. J. W. BUYERS, Engineer-in-Chief, Toungoo-Mandalay Extension, left Rangoon, accompanied by Mr. H. F. White, Superintending Engineer, Burma Provincial, to inspect the new line from Thawatee to Pyinmana preparatory to its being opened for passenger traffic.

INCREASED facilities are to be afforded for the stowage of goods in the Madras Harbour. The foundations of two sheds, one on each side of the shore-end of the pier, for the reception of export cargo, have been laid, and the work is being pushed on as rapidly as possible to secure early completion.

THE main result of Sir Edward Buck's and Colonel Thuillier's recent tour in Bombay and Madras has been a decision to employ for the conduct of forest surveys a section of the Survey of India Department under the general control of the Presidency Governments, in lieu of the construction of a new Forest Survey Department in each Province.

LIEUTENANT-COLONEL D. G. PITCHER, the Director of the Department of Land Records and Agriculture in the North-Western Provinces and Oudh, who has just gone home on leave, will not return to his appointment in the above Department when he comes back, the Local Government being of opinion that the post should be held by a Civilian.

ON the suggestion of Mr. H. St. A. Goodrich, Collector and President of the District Board of Bellary, who has discovered that a belt of plain trees of moderate height and thickness planted between an irrigated tract and a crowded locality, will usually protect the latter from malaria, the Hospet Taluk Board has adopted the suggestion and directed its being carried out wherever possible.

GREAT inconvenience having been caused to the Forest Department in the North Arcot District in conveying forest produce, &c., from the town of Virinjipuram to the Virinjipuram Railway Station, the North Arcot District Board has, on the application of the



District Forest Officer, sanctioned, for a period of about 4 or 5 months, the use of the side of the road for the construction of a tramway, on the condition that it is to be worked under proper precautions.

MR. D. B. ALLEN, the Collector of Pooree, who was about to proceed on privilege leave, has had to forego his holiday, as the spread of scarcity in his district is disquieting and a scheme of relief works may have to be organised. The scarcity is greatest in the Kheorda sub-division, but great confidence is felt in Mr. W. C. Taylor, the Deputy Collector in charge. Mr. Taylor knows the country intimately and is certain to take measures in time to avert any loss of life.

At midnight on the 8th instant the earthwork of the Railway line between Dina and Jhelum was breached through heavy rain. Another small breach of Railway line occurred owing to rain on the Sind-Sagar State Railway between Lilla and Golepore, on the morning of 8th instant. A collision was also narrowly avoided at Domeli Station, where the up and down trains, by some neglect at the points apparently, were turned on to the same line and came within fifty yards of each other.

## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

### PLATE-LAYING.

SIR,—Could you oblige me with the name of any small rudimentary book on platelaying adapted for platelayers. I don't mean such a book as Donaldson's or even Jones's, but something which commences at the very commencement. An answer in your paper will oblige.

F. J. PRESTON.

AKOLA, BERARS; August 6, 1888.

### HINDU HOSTEL, CALCUTTA.

SIR,—In your issue of 4th August 1888, you say, with respect to the Hindu Hostel recently built, and in which cracks have now appeared, that the foundations were designed so as to press nowhere with a greater load than a ton per square foot. But I remember perfectly well having seen the Government ruling, which was based on some experiments made on the Bengal soil, that the pressure on foundations was not to exceed  $\frac{3}{4}$  a ton per square foot. I cannot at present lay my hands on the ruling, but I have no doubt some members of the profession will be able to quote the number and date of the said ruling.

PUNJAB.

### MR. DICKSON'S CASE.

SIR,—Many of your readers are no doubt aware of the result of Mr. Dickson's case which recently occupied the attention of the High Court. In this connection, it would be curious to know whether it would be *lawful* on the part of Government to dispense with the service of an uncovenanted officer of the P. W. D. graded as permanent (substantive) in the classified list, on the usual plea that his services are no longer required in the interests of the public service. This is a question of some interest to those who will have to go to the wall in the approaching vigorous application of the shears to the establishment, about which the atmosphere of the P. W. D. is now so full of rumours.

August 9, 1888.

NON-REGULATION.

### DEEDS NOT WORDS.

SIR,—An American paper proclaims that two years hence a century will have gone by since the first successful crop of sea-island cotton was raised by William Elliot in South Carolina. Taking time by the forelock it is proposed to elaborate a plan for worthy celebration of the centenary of the staple that has been such an important factor in the fortunes—and misfortunes we would add—of the Southern States of America. The Yankees are as fond of *tamashas* as Bengalees, as spendthriftly premature in announcements as Lord Dufferin's resignation, as surely yielding, first place to India in the world's cotton (and wheat) markets as they say they are not. Increased export trade in cotton (and corn) should now be the endeavour of Indian patriots rather than Local Self-Government, and platform oratory, and similar unremunerative fads.

PROGRESS.

### INSPECTION OF INDIAN COAL-MINES.

SIR,—We are glad to see from your last issue, of 11th August, that you have called attention to the distress of the *Englishman*

about our Indian Coal-Mines Inspection. It seems quite evident that some party has had the loan of the Editor of the *Englishman's* capabilities to blow the trumpet of "By far the ablest mining authority in India." I should have thought that even an *Engineering* or *Mining Journal* would have been reluctant in expressing such an opinion. There are very many well-known mining men in different parts of India who have had far more experience both in England and out here. "By far the ablest mining authority" has had no experience as an English Colliery Manager. The East Indian Railway Collieries were laid out years before he came to India, by an experienced staff of assistants. I would ask the *Englishman* what he has done in the mining interests of India to deserve the appellation, and be puffed into the position the *Englishman* chooses to place him.

He has certainly been trying to introduce another system of mining. So are others introducing better ones as the natives are getting more accustomed to mining in general. "By far the ablest authority's" predecessor laid out the work on an improved system to that then in vogue, and which was considered more adapted to Indian mines. But perhaps the *Englishman* bases its opinion on the fact of "By far the ablest authority in India" introducing the electric light down one of his pits. It is no secret that this has proved to be an expensive failure, and one which any commercial company would never have attempted.

This suggestion of Mining Inspectors leads me to think that somebody is evidently anticipating a decent little living for doing nothing. Perhaps the Editor of the *Englishman* will now tell us who he recommends for the appointment.

SECOND TO NONE.

BLOW HARD COLLIERY;  
August 12, 1888.

### THE TRANS-DAMUDA COUNTRY.

SIR,—In your issue of the 4th instant has appeared an editorial leader on the proposed "Western Bengal Railway Scheme," which emanating, as it does, from so high an authority as Sir Bradford Leslie, is certain to command the support of the public, both in England and this country. By facts and figures he has shewn that the new line, far from being a drainer on the income of the E. I. R., will serve as an auxiliary towards its further development, and this assurance will stand in good stead in inducing capitalists to invest their money in the scheme.

The line, if carried into effect, is calculated to be paying from the consideration of external products of the rice producing tracts in the districts of Burdwan and Beerbhoom. Apart from this, it is not unlikely that many new industries will spring up in developing the mineral resources of the country between Baidyanath and Beerbhoom, which was discussed in this paper a short time ago by Mr. Agabeg when writing about the urgency of a tramway or Railway from the Sonthal Pergunnahs to the E. I. R. The proposed line will cover the country noticed in Mr. Agabeg's scheme.

This project will open out the resources and stir up the trade of a tract of hitherto inaccessible country; and Sir Bradford Leslie deserves the heartfelt thanks of a vast amount of population for putting before them a great promising future of the country inhabited by them.

While admitting the usefulness of this proposed scheme, it naturally pains us to think that for want of an encourager like Sir Bradford Leslie another similar tract of Bengal (the trans-Damuda country) is laboring under the greatest disadvantages of trade and agriculture for want of the means of rapid transport of goods.

A part of this territory has just been visited by the Lieutenant-Governor of Bengal on his way from Midnapur to Bankura, and although matters were pointed out in their real colors, Sir Stuart Bayley, in spite of the difficulties experienced by him on the journey (for we understand by the swelling of the Darkepur and all the other streams that fall on the route, the timing of his programme had to be considerably altered) expressed in reply to the address of the people his inability to attend to the prayer, inasmuch as the question of the extension of the Tarkessur Railway did not rest with him, but with the Government of India. It is a pity that Sir Stuart deemed it fit to dispose of this important question which conduces so much towards the material improvement of the country with so slight a consideration.

The people of Bankura naturally are a very quiet sort of people, never willing to go up to Government for any consideration towards them, unless they find it very absolutely necessary; and looking around them the prosperity which the Railway has given to other parts of Bengal, they took advantage of this opportunity of the Lieutenant-Governor's visit in introducing this question, but all their eager expectations were nipped in the bud by the most discouraging reply that fell from the lips of the ruler of the country.

If the local ruler had given any hint as to the advisability of submitting a memorial on the subject to the Government of India, no doubt the people would have adopted that course, but from the summary way in which the question was disposed of, the spirit of the people, it is feared, has been damped, and it will be some time before they shall have courage enough to revive the question and make a representation to the Government of India.

The extension of the Tarkessur Railway across the Damuda to Jehanabad, and further on westwards, till it joins the Bengal and Nagpur Railway, has become a necessity of the times; as it can



be inferred from the fact that even the Lieutenant-Governor, at whose disposal must have been placed all the possible advantages of a journey, had to put up with difficulties. What much more would they be to the poor ryot and the trader baffles the power of description, and could be better imagined than described. The question must therefore have to be brought to the notice of the Government of India, who will no doubt give the matter the consideration it deserves.

The construction of this line if sanctioned by Government, will no doubt, be gladly undertaken by the Bengal and Nagpur Railway Company, inasmuch as it will be a most useful feeder to their main line, and at times of pressing traffic on the E. I. R. will serve as an easy outlet for the removal of all unforeseen blocks.

It may also be stated here that the merchants of the districts of Bankura and Burdwan carry on an extensive trade both in import and export produce with Chutia-Nagpur, and all this trade is now purely carried on by country bullock-carts, which will all pass along the proposed extended line of Tarkessur Railway. It is high time that Government should be represented to about the urgency of the scheme, and no doubt, when once explained, it will merit the desired consideration at its hands.

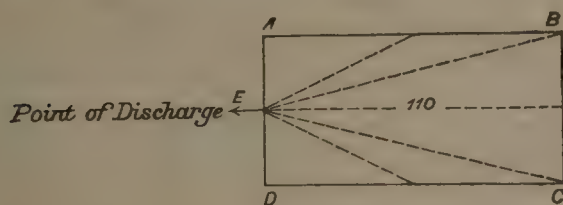
R. N. B.

#### NOTE ON THE FAILURE OF THE KALI NADI AQUEDUCT IN THE LOWER GANGES CANAL.

SIR,—On reading your interesting article on the failure of the Kali Nadi Aqueduct in INDIAN ENGINEERING of 23rd June, I applied my formula as well as I could and the data given, and enclose the result for your consideration and insertion in your journal should you think it of sufficient interest.

No plan of the catchment basin accompanies the article on the above subject (*vide* INDIAN ENGINEERING of 23rd June 1888), but the following data are given:—

Area = 2,377 square miles. Length of basin = five times its width. The shape of the basin probably approximates to a rectangle, thus



divisible into these triangles ABE, BEC and CED, the first and third equal, or may be assumed equal to each other.

The dimensions of these three triangles, *viz.*, L and B being

(1)	(2)	(3)
L = 56 miles.	L = 110 miles.	L = 56 miles.
B = 10.4 "	B = 10.8 "	B = 10.4 "

and applying the formula suggested by me for flood sectional areas we obtain

Flood section area of stream in ft.

$$= 80 B \log_e \frac{4L \left\{ L + \sqrt{L^2 + \frac{13^2}{16}} \right\}}{\Pi}$$

For triangle (1)	$= 80 \times 10.4 \log_e 2,433 =$	s. ft.
Ditto (2)	$= 80 \times 10.8 \log_e 8,963 =$	7,874
Ditto (3)	= same as (1)	= 6,488

Total maximum flood section = 20,850

which, with the velocity assumed by Colonel Forbes, would almost give the estimated discharge of the flood of 17th July 1885.

Should the shape of the catchment basin approximate more closely to that of an isosceles triangle, with the point of discharge in the base, as is possibly the case, the result would be slightly greater, but the margin for safety allowed in the new bridge will amply suffice for all possible contingencies.

BRIDGE OF ALLAN, N. B.; } J. CRAIG, M. INST. C.E.,  
18th July 1888. } Executive Engineer, P. W. D.

#### LIMES AND CEMENTS.

##### II.

SIR,—It is a question whether the very fine screening of gooting lime, after slaking, does not deprive it of some of its hydraulic quality, for it is reasonable to suppose that those particles of the gooting which contain most clay, won't slake and remain in small lumps too large to pass through the screen. Gooting lime is decidedly only feebly hydraulic, and every improvement in its manufacture that will preserve this quality should be encouraged. Slaking the gooting before screening is another injurious process;

the gooting should be burned as free from ash and external impurities as possible, ground to an impalpable powder and packed in bags and kept dry. Then only can an Engineer rely upon its setting eventually quite hard under water.

1. It has been urged that the fact of a small sample of 100 grains passing a test does not stamp the bulk as good or bad. What are the results of experience? If 10 or 12 tons be tested in the way I described, it will be found that any number of samples so drawn will agree within 3% to 4%. The theory of our test is this, if any portion of the lime shews more than 33% of residue it is liable to rejection. Such a rule strictly applied would be unfair; for no matter what care may be taken by the manufacturer to mix the contents of his kilns, it is probable that some portion may give 10% more or less residue. As a matter of experience, if I know the locality of the manufacture, I can tell off-hand what the insoluble residue in an average specimen is likely to be.

Not only this, but the 33% test has resulted in our obtaining lime of an average of only 30% residue.

2. I will dismiss the discussion of the efficacy of a 33% test with this remark. Although we have carefully examined waggons at one end of the line, it has occasionally happened that they have been unloaded for the substitution of bad materials, and even before the despatch of a waggon of lime an anonymous communication has resulted in the detection of the substitution of worthless materials: such are the lengths which the small local lime maker is prepared to go, not only cheating the consumer, but also the vendor or broker.

3. But let us see what further tricks can be played upon the man who does not adopt a residue test of some kind. In those parts from which nearly all the gooting lime comes which is used in Calcutta and round about, there are strata of calcareous earth which produces the most beautiful imitation of good gooting lime that can be imagined. Mixed with bad gooting or sand, it cannot be detected by the eye; worse than this; it makes up into such a compound as to inevitably lead even the experienced man to select it in preference to honest gooting lime. As I have already remarked, the colors of gooting limes are extremely variable, and it is because this adulterant produces a fineness, softness and color which imitates to perfection the best gooting lime that it is so dangerous. But it may be urged that the practical bricklayer cannot be taken in by it. All I can say is, that such a belief is likely to end in disaster. I am no chicken, for I can score eight-and-twenty years of Engineering experience, yet I am bound to confess that until I practised a residue test, I was absolutely in the dark as to the subtleties of the lime trade. As soon as I found out my ignorance, I have been charitably employed in exposing that of a lot of men who, I thought, knew more than I did.

4. To this end I collected *bond fide* specimens of highly adulterated lime, and concocted a few of my own, and submitted them to the eye, nose, and taste test of practical men for opinion. It is melancholy to have to record that the more nearly were the true appearances and good qualities of gooting limes perverted, the more successful was the take in. Encouraged by these successes, I went a step further, I dissolved out all the lime from good gooting limes, and collecting the residues, formed them singly and mixed with other ingredients into separate heaps and called in a jury of practical bricklayers. At the risk of being charged with trying to impose on the credulity of your readers, I must nevertheless record that in most cases the simple residues were pronounced the best; the mixtures the next, while the honest gooting lime was invariably the worst!!!

5. But perhaps some one will retort "that sort of take in may be possible, but you cannot possibly conceal the smell and taste of good lime." Why not? The senses of taste and smell are differently developed in individuals. Let us see how we can take in such an unbeliever; very simply, a few bucketsful of whitewash made from fresh unslaked lime will impart all the bouquet and flavor necessary to dead lime, sand, or any other imitation, to deceive even his acute senses. But he again may urge, "if you lay aside deliberate dishonesty, you cannot be taken in." My reply is—why lay aside the possibility or probability of dishonesty—when all experience shews that if money can be made by dishonest means, you have no safety but in the absolute good faith of your vendor—and even *being given that*, what guarantee is there against his having been taken in at the outset? I will not, however, press my argument home in this way, but will simply state as a fact of my own experience that I have not been able to detect any material differences in such qualities in the instances of ordinary fresh lime and stuff that was useless. Lime may be as dead as a door nail and yet retain sufficient taste and smell to deceive the most sensitive individual.

6. "Eureka's" regrets at the absence of all provision on the part of Government for the experimental and scientific testing of limes must be shared in by all Engineers. No one has been more hardly hit than the Government of India itself by failures in its public works. It is not fair to say that the officers in charge of those works were alone to blame. Men with multifarious details to attend to cannot find time for proper testing. Whereas if there existed a department to which specimens could be submitted, there would be nothing easier than for an inspecting officer to take out actual examples of lime and mortar from his works, and ask for opinion thereon. I will venture on a bold assertion,



ric, that such a thing is seldom, if ever, done in any shape. Eyes, nose, and taste alone have been employed to deal with the most important element in the work and one too where eyes, nose, and taste are blind leaders of the blind. In another way, too, work might always be found for such a department. In the cold weather they might be employed in exploring and bringing to notice the different kinds of lime stones available in each Public Works Division, and preparing the way for the innumerable schemes which the future will see inaugurated; and so facilitate the work of Engineers who are repeatedly called upon to make estimates in an unknown country without any idea if the materials are at hand to make such estimates reliable.

7. But says the general consumer of lime, "what am I to do to secure good lime," or says the Engineer who is obliged to go into the market for it, and cannot possibly test each consignment "what am I to do?" I can only say to both, "your only safeguard lies in dealing with firms of the highest respectability who are *bond fide* makers of all the lime they sell, are not employers of middlemen, and are not in any sense vendors or brokers—for my experience tells me that these vendors and brokers are as systematically victimised as you would be—if dealing direct with the lime burners.

8. In conclusion, I can only express a hope that my remarks may open the eyes of Government in particular, and Engineers in general, to the very serious risks they now run.

R. C. M.

#### A WESTERN BENGAL RAILWAY.

SIR,—The idea of extending the Oudh and Rohilkhand Railway to Calcutta by the route shown on the map accompanying the article and memorandum published in your last issue, may have originated from Sir Bradford Leslie or Mr. Horace Bell, but it is none the less an unacknowledged compilation from two schemes first brought before the public years ago. One, the Grand Chord Line of the East Indian Railway from Moghal Serai to Barakur, and the other a Railway proposed by Messrs Burn & Co., to run through the Sonthal District connecting Byjnath, Nya Doomka, Soori, Cutwa, and Burdwan, and with branches to Bhagulpur and Moorshedabad.

The so-called direct line lessens the distance between Benares and Calcutta by 19 miles, whereas the Grand Chord Line decreases the distance by 60 miles. The map annexed will shew how small is the deviation in the new proposal from the routes given in the old proposals.

The average cost of broad gauge Railways in India of over 200 miles in length is Rs. 1,72,307 per mile, and the working expenses are 50·82 per cent. of the gross receipts, as against Sir Bradford's estimate of cost—Rs. 90,000 per mile and working expenses 40 per cent. of gross receipts. The bridge over the Sone River is included in this all-round rate of Rs. 90,000 per mile, and as the only other Railway bridge over this river cost 33 lakhs, the estimate is reduced to about Rs. 82,000 per mile for the rest of the Railway. Either these estimated figures are absurdly low, or the Government is largely to blame for having spent, or permitted to be spent, twice as much as necessary in constructing its Railways, and also for working them at a cost over 25 per cent. in excess of what can be done.

Between Gya and Byjnath, fifty miles of the new line is shewn to run obliquely through the Behar mountains. The cost of this length with the necessary gradients to cross a range of hills 2,000 feet high, would undoubtedly exceed even the average cost per mile of other Indian Railways. Therefore, taking the very favorable estimate of traffic given, and including the 14 lakhs at Moghal Serai and the "few lakhs" of trade generally robbed from the East Indian Railway, the interest on capital cost will probably not exceed 3 per cent. per annum.

Sir Bradford's figures, said to be obtained from "the most recent official information," make Bengal a most benighted province in the matter of Railways; but the figures contained in the "Administration Report of the Railways in India, 1886-87," give very different results, as the following table will show:—

PROVINCE.	SIR BRADFORD LESLIE'S FIGURES.			STATISTICS GIVEN IN THE GOVERNMENT ADMINISTRATION REPORT.		
	Miles of Railway open.	Square miles of territory per mile of Railway.	No. of inhabitants per mile of Railway.	Miles of Railway open.	Square miles of territory per mile of Railway.	No. of inhabitants per mile of Railway.
Punjab ..	1,600	73	11,647	1,685	63	11,187
Bombay ..	2,106	94	11,573	1,883	65	16,893
Madras ..	1,544	99	22,090	1,478	94	11,156
N.-W. Provinces ..	1,484	75	30,222	2,197	48	20,076
Bengal ..	1,574	110	44,174	1,970	76	33,253

It will be seen that in no single item are the figures given in the memorandum on the new Railway correct.

Again, it is stated that "Western Bengal.....a territory of 60,000 square miles with 22 millions of inhabitants...is served by...701

miles of...Railway" only. The Administration Report must be wrong again here, (unless the memorandum is untruthful), for it gives 845 miles of Railway open in the same territory.

In exchange for the traffic to be taken from the East Indian Railway, the promoter offers the carriage of the material and coal for the new line! A most magnanimous offer!

The breaching of the East Indian Railway between Luckee Serai and Moghal Serai, far from being of "not unfrequent occurrence" has never occurred.

The last paragraph of the memorandum is more amusing than anything else. The Oude and Rohilkhand and Bengal and North-Western Railways are now in keen competition for the traffic of the province through which they run on opposite sides of the River Gogra, but when the new line is constructed provision is to be made for both to run on the same road bed! What the competition would amount to then, it is difficult to imagine; but would not such a proceeding rob the new W. B. Railway of a large amount of its estimated 47 lakhs of earnings, or is it part of the scheme that the B. & N. W. R. Co. is to simply carry its own less than 100,000 tons per annum of produce sent to Howrah, with an understanding that no other traffic is to be picked up on the way. Besides the B. & N. W. R. is about 65 miles away from the nearest point (Gya) of the proposed Railway, and this length of line required will either have to include a bridge over the Ganges between Paleza and Digha Ghāts, or else the present and expensive method of transshipment will still have to be adhered to. The distance to Calcutta from Bankipore would be nearly 40 miles more by the new Railway than by the present route.

Altogether, Sir Bradford Leslie's memorandum exhibits a strange misrepresentation of figures, a totally inadequate estimate of cost and working expenses, a very liberal and unwarrantable estimate of traffic, a fair amount of plagiarism, and one or two suggestions savoring more of the ridiculous than the sublime.

F. P.

August 13, 1888.

#### STRAY NOTES FROM SCOTLAND.

SIR,—Some notes of home matters in North Britain may not be devoid of interest to your readers. Our Exhibition has been a great success, I mean the latest. We expect the Queen on 23rd August to inspect it.

We are busy arranging for the approaching visit of the Institute Naval Architects, the meetings will take place on 24th, 25th, 26th and 27th of this month. Two local papers will be read.

(1) On "Recent and Projected Improvements on the River Clyde," by James Dear, C.E.

(2) On "The First Century of the Marine Engine," by Henry Dyer, Esq., M.A. The other papers will deal with Yachts, Copper Pipes for Marine Engines, Steam Trials, High Explosives, &c. We have formed a large Reception Committee and have arranged a series of excursions to works, and on 27th one to "Inverary" by the *Iona*. The "Iron and Steel Institute" meet this year in Edinburgh in August, and as one of their excursions is to Glasgow, to see the International Exhibition, a Reception Committee has been formed to entertain the visitors on the 24th August.

Glasgow is receiving a number of visitations from Societies this year, as, besides those mentioned, there are the Society of Chemical Industry, the Highland and Agricultural Society, The Medical Society, North British Association of Gas Managers, the Society of Librarians, &c., (the first named Society has now held its meetings).

I am afraid the Indian workers and attendants at our Exhibition must feel the cold dreadfully, as the weather has been abnormally cold for the season; the average temperature of June here having been the lowest for the last ten years.

The *City of New York*, the largest steamer in the world after the *Great Eastern*, is now nearly ready to leave the Clyde for her station between Liverpool and New York. The *City of Paris*, a sister ship, will likely be launched in August; they are twin screws, working up to about 20,000 I. H.-P.

M. J. W.

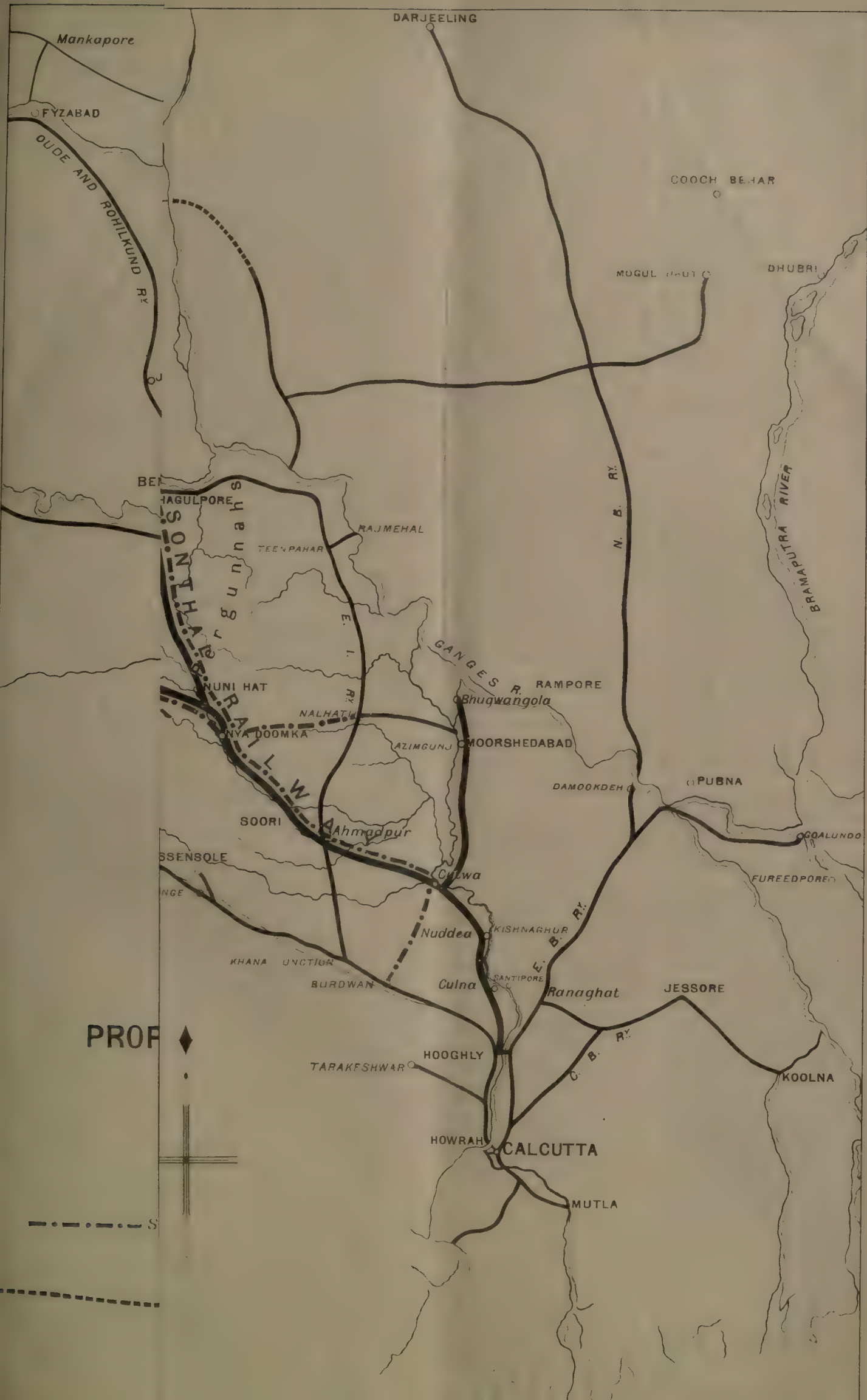
GLASGOW; July 16, 1888.

#### ARGENTIC-GALENA LODES OF MYSORE.

SIR,—The earliest notice of the occurrence of silver in Mysore is to be found in the *Jaimini Bhārata*, a Canarese poem, by Lakshmisā, descriptive of the great *Asvamedha* or horse sacrifice undertaken by the Yudishthira. Bahhruvahana, the son of Arjuna, reigned in Manipur (Chamrajnagar, Mysore), and of his wealth it is said: "Many thousands of chariots were employed in bringing in the revenue in gold and silver." This Prince was in alliance with the *Nagas*, a powerful race inhabiting the mountainous country to the west of Mysore, where there were mines of gold and silver.

Pliny (A.D. 77) speaks of the country of Narex as containing numerous mines of gold and silver. It is thought that by the country of the Narex the Nairs of Malabar were meant, but with











more probability the country of the Nagas,—the high regions of the Western Ghats more likely to contain mineral deposits, than the alluvial plains of Malabar inhabited by the Nairs,—was referred to.

The singular absence of all traces of a silver coinage in Mysore, until very recent times, has been pointed to, as evidence of the scarcity of this metal in the Province, but that this fact means more than that silver was not used for coinage, is yet to be proven. Many localities in Mysore still bear the Canarese name of Belli-Betta (silver hill), and here there are undoubted traces of mining, in the shape of old shafts and drives, and in extensive clumps of metalliferous gangue, adjacent to these workings; but whether the metal sought for was silver, has not yet been substantiated.

Ainslie states that Captain Arthur discovered this metal in small quantities in Mysore, both in its native state, in thin plates adhering to some specimens of gold crystallized in minute cubes, and mineralized with sulphur, iron and earthy matter, forming a kind of brittle sulphuretted silver ore (Rice's *Gazetteer*, Mysore, Vol I., page 17).

Belli-Betta, in the Attikuppa taluq, where there are numerous old mines, is reputed to be immensely rich in ores of silver, but Mr. Bruce Foote, Superintendent, Geological Survey of India, who visited this locality in the early part of last year, was unable to find the slightest trace of any ore of silver.

Tradition pointed to Belligudda, in the Chitaldroog taluq, as having been worked by the ancients for silver, but here, too, Mr. Bruce Foote was unable to find any silver. He says, "Belligudda is a fine hill lying some five miles south-east of Chitaldroog, on the western flank of which are four large open pits, and several small shafts and galleries sunk in clay schist, in order to extract copper ore, which occurred there in the form of malachite or green carbonate \* \* \*. A few fragments of quartz with small particles of rich malachite were picked out of the attle tipped down the very steep side of the hill, but no trace of any other ore or metal could be discovered after very careful search." Since Mr. Bruce Foote's visit, this neighbourhood was carefully examined on behalf of the London Exploration and Mining Company, to whom the Government of Mysore had granted the right of selecting a square mile of land, for gold-mining purposes; while prospecting for gold, several quartz-reefs rich in galena were discovered, and it is to a description of these reefs that this letter is more particularly confined.

Chitaldroog (N. L. 14°15', E. L. 76°29'), one of the most famous of the many hill-fortresses of South India, gives its name not only to the taluq in which it was situated, but also to the northernmost of the eight districts into which Mysore is divided. The whole of this district is traversed from south to north by the central band of the Dharwar rocks, described by Mr. Bruce Foote (*Records*, Geological Survey of India, Part 2, Vol. XXI). This band is divided into two branches near the town of Chitaldroog, by the intrusion of a tremendous upheaval of porphyritic granite, traceable in low ridges and isolated peaks as far as north Huchangi Durga, in the Bellary District, while the schistose series continue also in a northerly direction till lost in the Dharwar country.

The hills forming the eastern boundary of the taluq consist of hornblende, chloritic, micaceous, hæmatite and argillaceous schists associated with massive diorite. The general strike of these rocks is a little to the west of north, but subsequent volcanic action, recognised in the presence of numerous lava dykes, appears not only to have rent and split up the granite hill of Chitaldroog, but to have so contorted and folded the schist series as to make it difficult to determine the run and dip of these rocks with any exactitude. To such volcanic action, too, is probably due the highly metamorphosed condition of the quartzite beds occurring here, and it is easy to mistake the white, crystalline ridges of this material for true quartz reefs.

Numerous quartz veins, from a few inches to many feet in thickness, and varying in color from milky white to a blue-black, traverse these Dharwar rocks in a north-north-westerly direction, apparently in the same general run as the country rock. On the hill-sides the reefs are easily traceable from their outcrops, but in the valleys they are lost in the outspread of black-cotton soil.

That portion of the schistose band lying some four miles north of the town of Chitaldroog, and near the village of Gonur, was examined by Mr. Bruce Foote, who found gold in quantity in the alluvium, but was unable to find a trace of it in the reefs he tested. The result of his gold-washings was so good, that he considers this tract one of the most promising he has seen in Mysore. The southern extension of this band at Belligudda, seven miles from Gonur, was also visited by him, and he believes that malachite, green carbonate of copper, was the ore sought after here. Midway between these two localities, galena has been discovered in three separate reefs.

Near the 119th mile-stone of the Bangalore-Harihar high road, and about a hundred yards south of the road, is an out-crop of quartz traceable for about a furlong or so. The reef here is about 2 feet wide, and of a milky white appearance. The galena occurs in shoots or chimneys in the body of the quartz, nearer the foot wall of the reef. Clusters of steel-grey crystals of the ordinary cubical system, making lumps the size of one's fist, are frequently met with, while small nodules of finely granular varieties are not uncommon. Mixed with the galena are specks of copper pyrites

and green carbonate, and occasionally inclusions of plumbic carbonate (white-lead ore). At the 121st mile, and near the village of Kunchinal, is a second reef, somewhat wider than the first-mentioned. The ore here occurs in narrower shoots, is of a steel-blue colour, and highly impregnated with copper, which stains the whole bulk of the quartz and gives it the appearance of poor malachite. Apparently the reef has been here worked by the ancients, as several shafts and open cuts are still in existence behind the village of Kunchinal, and numerous small shafts on the hill-side, about a mile north of the village. Both the reefs described are on the eastern slope of the Jogi Mattee range of hills, while the third reef is on the western slope of the hills, and near the town of Chitaldroog. Here also the quartz is of a milky white colour, streaked with layers of chlorite. The gangue is extremely rich, containing nearly one-third of ore, but the reef is small, averaging not more than a foot in thickness. The ore is finely granular and distributed in patches throughout the quartz, and is remarkably rich in silver, assaying as high as 200oz. of silver to the ton. Samples of ore from all three reefs were sent to London, and assayed there, with widely different results. All shewed silver in varying proportions? some samples extremely high, others very poor, yet all worth working if the ore can be had in quantity. More carefully selected samples have been again forwarded for assay, but the results are not yet forthcoming. It is known that silver is invariably associated with galena, probably as a sulphide, and the easy extraction of this metal from the lead, makes it possible to profitably treat ores containing as little as .005 per cent. of silver. Gold also is of constant occurrence in ores of lead, and two of the samples sent from the third-mentioned reef, not only contained a high percentage of silver, but an appreciable quantity of gold.

At present nothing more than a superficial examination of the reefs has been made, but negotiations are now being made with the Mysore Government, and it is hoped that very shortly deep prospecting and a thorough examination of the locality will determine whether these ore-deposits are worth working or not.

A. MERVYN-SMITH, M. S. A.

[In this connection it may be of interest to note that while recently carrying out some excavations on the site of the ancient city of Chandravalee, near the town of Chitaldroog, Mr. Smith unearthed a number of lead coins.—ED., I. E.]

## New Books and Reprints.

### ART AND ARCHITECTURE

- ACADEMY Notes, 1888. With Facsimiles of Sketches by the Artists. Edit. by Henry Blackburn 8vo. sd. Chatto and Windus ... 1/
- ACADEMY Sketches. Including various Exhibitions Edit. by Henry Blackburn 8vo. sd. W. H. Allen ... 2/
- BUTLER (Samuel) Ex Voto: An Account of the Sacro Monte; or, New Jerusalem at Varallo-Sesia. With some Notice of Tabachetti's Remaining Work at the Sanctuary of Crea. Post 8vo, pp. 284. Trübner ... 10/6
- GROSVENOR Notes, 1888: An Illustrated Catalogue; with Facsimiles of Sketches by the Artists. Edit. by Henry Blackburn. 8vo, sd. Chatto and Windus ... 1/
- HANDBOOK of the Italian Schools in the Dresden Gallery. By C. J. Fr. Post 8vo, pp. 296. W. H. Allen ... 3/6
- KURTZ (Charles M.) National Academy Notes and Complete Illustrated Catalogue. 63rd Spring Exhibition National Academy of Design, New York. Cr. 8vo, sd. pp. 156. Cassell ... 50c
- MacCord (C. W.) Practical Hints for Draughtsmen. 4to, pp. 100, Illust. New York ... 10/6
- New Gallery, 1888. An Illustrated Catalogue, with Facsimiles by the Artist. Edit. by Henry Blackburn. 8vo, sd. Chatto and Windus ... 1/
- OAKSHITT (G. J.) Detail and Ornament of the Italian Renaissance. Folio. B. T. Batsford ... 32/
- PARIS Salon: Illustrated Catalogue, 188. 8vo, sd. Chatto and Windus ... 3/
- PICTURES (The) of 1888 Pall Mall Gazette, "Extra," No. 41. 4to. sd. pp. 96. Pall Mall Office ... 6d
- RICHARDSON (C. J.) The Englishman's House: A Practical Guide for Selecting or Building a House. 4th ed, with a Coloured Frontispiece and 534 Illusts. Post 8vo, pp. 482. Chatto and Windus ... 7/6
- ROBINS (E. C.) Technical School and College Building: Being a Treatise on the Design and Construction of Applied Science and Art Buildings, and their suitable Fittings and Sanitation. With a Chapter on Technical Education. 4to, pp. 252. Whittaker ... 50/
- ROYAL Academy Pictures; Illustrating Fifty-three of the Principal Pictures and Sculptures in the One Hundred and Twentieth Exhibition of the Royal Academy. Being the Royal Academy Supplement of the Magazine of Art, 1888, 4to, sd. Cassell ... 1/
- SCHOOLS and Masters of Painting. With an Appendix on the Principal Galleries of Europe. Illust. by A. G. Radcliffe. 8vo. Appleton (New York.) D. Appleton ... 12/6
- SPARKES (J. C. L.) A Manual of Artistic Anatomy for use of Students in Art: Being a Description of the Bones and Muscles that Influence the External Form of Man. With Illusts. from Holden and Bourgeroy. Roy. 8vo. Bailliere ... 7/6
- WHISTLER's (Mr.) Ten o'Clock Sq. 16mo, sd., pp. 40. Chatto and Windus ...



## General Articles.

### HIGH COURT, CALCUTTA.

Our illustration this week represents the High Court of Calcutta as seen from a position in front of the Town Hall. This building is interesting not only as being the great tribunal of justice in the province of Bengal, but architecturally as one of the very few Gothic structures in the City, and constructionally as one in which stone was largely used as a building material.

In plan it forms a rectangular block with a quadrangle cut out from the centre: a verandah runs all round overlooking the courtyard; and the south face, seen in the illustration, is also protected by a wide verandah. The building is a three-storied one, the middle-floor being devoted to the Court Rooms, Judges' Chambers, Bar Library, &c.

Architecturally the building is based upon the Italian, rather than the purer forms of English-Gothic—the general treatment being fairly good. The tower which is placed in the middle of the south face has several good features as regards detail, but it certainly has the appearance of having sunk fathoms into the ground. No doubt this unsatisfactory result is due to some "cheese-paring" which one of our former responsible advisers was ignorant enough to recommend. The building covers an area of just over 100,000 superficial feet, and cost 18 lakhs of rupees.

It has on several occasions formed the subject of alarmist reports among the public owing to the decay of some of the stonework in the groins and piers. A certain amount of shoring and pinning has been resorted to, and parts have been examined, strengthened and replaced. This experience on a large scale may be said to have settled the fate of stone as a building material in Calcutta.

### NOTES ON NAVIGATION.

By A. EWBank.

#### IV.

Now let us consider the equator not as being a curved line, but as a plane circular area enclosed by that line.

From the point A in the rhumb line M A B G draw A A' normal to the equator, and to meet the equator in A A'. Similarly draw B B' and G G'. If we do this with every point in that part of the rhumb line which is north of the equator, we get in the plane circular area of the equator a certain spiral curve M A' B' G'..... Let P<sup>1</sup> be the centre of the earth, so that P<sup>1</sup> bears the same relation to P as does A<sup>1</sup> to A. Then the spiral M A' B' G'..... will circle round P<sup>1</sup> and will continually approach it. The curve M<sup>1</sup> A' B' G'..... is called the projection, or—to be more precise—the orthogonal projection on the equator, of the rhumb line M A B G.

Such a projection would not be suitable for map-making, because the land or water near the north pole is fairly represented in the projection, while spaces of and or water near the equator are considerably reduced.

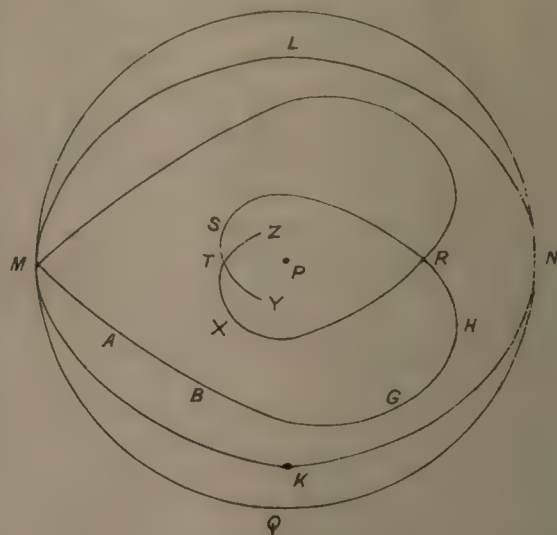
The projection, however, may be useful when we only desire to study the geometry of curves on the sphere. If from P we draw meridians P M, P A, P B, &c., at equal angles or equal differences of longitude these in the projections become straight lines, P<sup>1</sup> M, P<sup>1</sup> A<sup>1</sup>, P<sup>1</sup> B<sup>1</sup>, &c., making equal angles. In this case a curved line projects into a straight line. Generally a curved line projects into a curved line. Generally also if on the sphere we have two equal angles, the angles in the projection will not be equal.

If two curves touch on the sphere they will give touching curves in the projection. But two curves may touch in the projection without their original curves touching on the sphere.

For example, let M be a point on the equator, and M N a diameter. Through M N draw any great circle M K

N L. We may suppose K and L to be the vertices of this circle. It will in the projection become an ellipse, M N will be the major axis, and K<sup>1</sup> L<sup>1</sup> the minor axis. Moreover, the ellipse will be inscribed in the equator. The ellipse will touch the equator at M and N, although the original circle cuts the great circle of the equator.

Fig. 7.



These points are illustrated in fig. 7. M Q N is the equator, and M K N L is that ellipse which represents the original great circle. The letters are left unaccented. Thus P in the figure is the projection of the north pole.

From M on the sphere draw towards the north pole such a rhumb line as shall start north of the great circle M K. This rhumb line will keep north of M K, and after an unlimited number of circuits it will reach a point consecutive to the north pole.

In the figure we shew only one circuit M A H R S T. At the point T the curve does not proceed to X. It passes in the direction T Y, and makes continual revolutions round P.

Let us now start from T and proceed in the direction T S R G. Thus in time we again reach M.

If we continue our path along the rhumb line we cross the equator. Here the rhumb line has its point of inflexion, and thereafter it gradually nears the south pole by an unlimited number of quasi-circuits.

This south part of the rhumb line may also be projected on the equator, and thus we obtain the portion M J R X T. This projection meets the projection of the north part of the rhumb line at R and at T and at other points not shewn in the figure. These other points are between R and T. The curve we are now following in reaching T proceeds towards Z.

If we endeavour to represent many turns of the rhumb line, our figure becomes complicated, unless it is drawn on a large scale and with extreme care. Orthogonal projection does not preserve the original relations between angles. Thus in fig. 7 we must not expect to find any constant angle corresponding to the parameter  $\gamma$  of the real rhumb line.

We may use the projection of fig. 7 to answer the following question. We are given a complete rhumb line—that is, we have the series of spiral turns in each hemisphere. It is required, if possible, to draw a great circle on the sphere which shall nowhere meet the rhumb line. If the projection of such a circle is made, we shall have possibly that part of the projection which is on the right of P, escaping the rhumb line.

But that part of the projection of the unknown circle which passes left of P must encounter M J R and M A R. If this part of the projection of the circle belongs to the northern half, we see that the original circle must be cut by the northern part of the original rhumb line, and

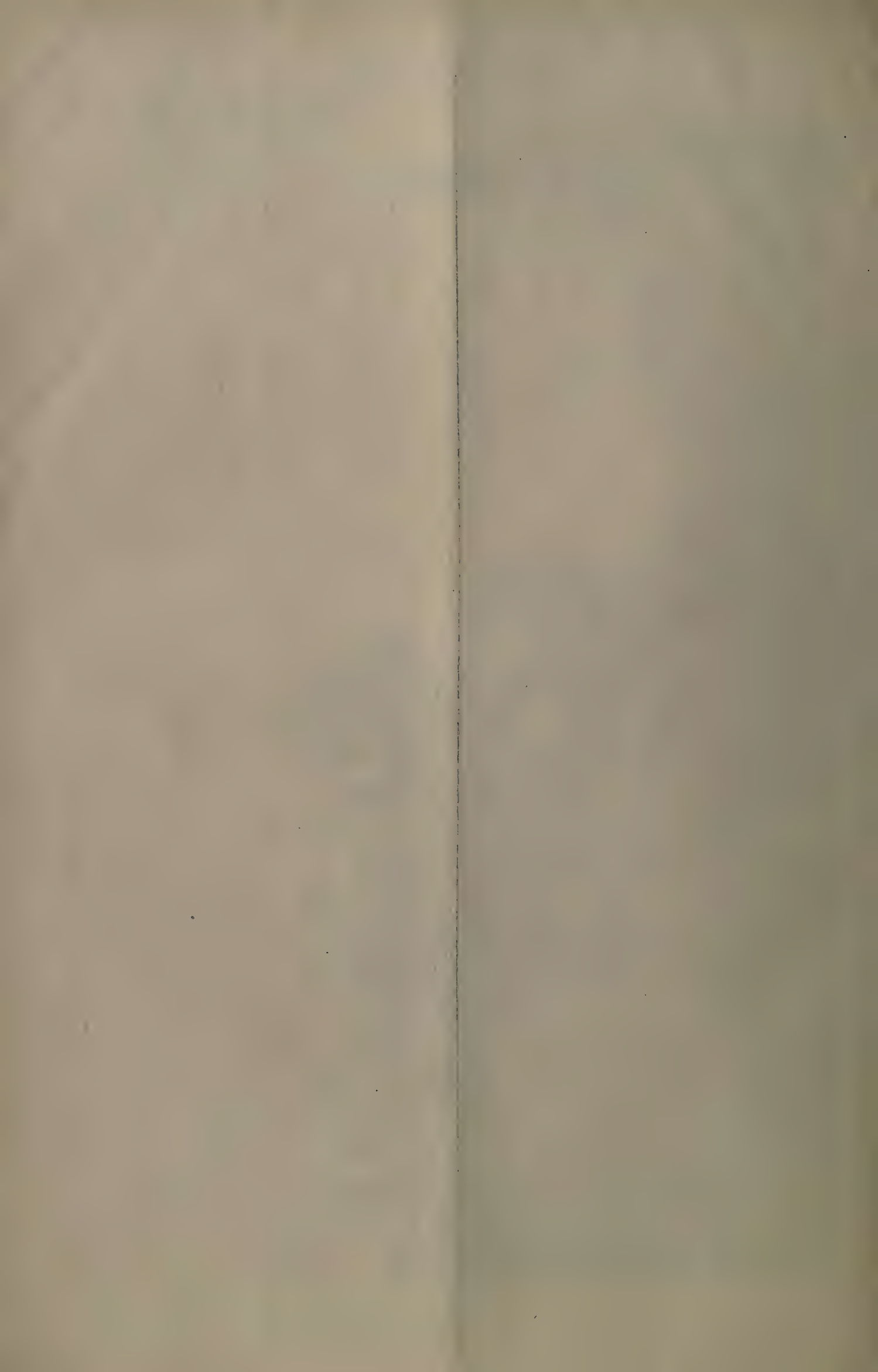


INDIAN ENGINEERING.



PHOTO-TYPE by James Akerman & Queen Square London W.C.

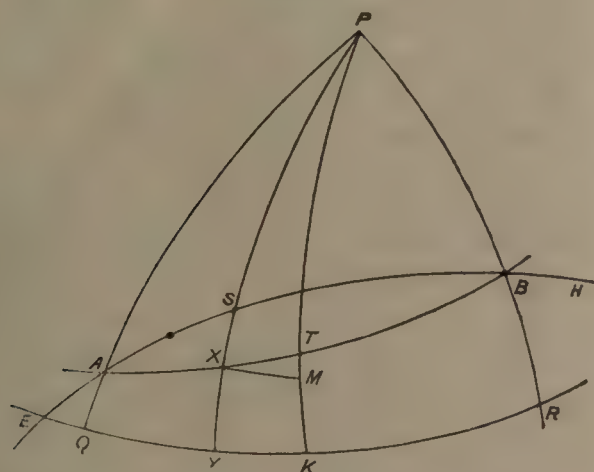






if this part of the projection of the circle belongs to the southern half, we shall on the sphere have the southern half of the rhumb line ready to meet it. It would not be so simple to answer this question without the aid of our projections.

Fig. 8.



We may now investigate a formula which shall give us the parameter  $\gamma$ . In *fig. 8*, A and B are given points on the earth between which we wish to run a rhumb line. This rhumb line is A X B. It will pass south of the circle A S B.

E Q =  $\lambda_1$  = longitude of A.

as we may conveniently measure longitudes from the point E where B A meets the equator.

E R =  $\lambda_2$  = longitude of B.

Q A =  $l_1$  = latitude of A.

R B =  $l_2$  = latitude of B.

X is any point on the rhumb line between A and B.

E Y =  $y$  = longitude of X.

Y X =  $x$  = latitude of X.

The angle P A X is the parameter  $\gamma$ .

If T be a point on the rhumb line and near to X P X T also equals  $\gamma$  = P T B.

The latitude of T = K T = K M + M T = X Y + M T =  $x + \delta x$ .

where  $\delta x$  denotes a small increment of  $x$ .

At present all the arcs are reckoned in circular measure and not in degrees.

Y K =  $\delta y$  = increment of longitude as we pass from X to T.

X M T is a small right angled triangle. As the sides are small we treat it as a plane triangle. The length of the arc X M = Y K Cos Y X = Y K Cos  $x$ .

$$\text{Thus } \cot \gamma = \frac{T M}{M X} = \frac{\delta x}{\delta y \cos x}$$

$$\text{Or } \delta y \cot \gamma = \frac{\delta x}{\cos x}$$

This equation we integrate between the limits  $\lambda_2$  and  $\lambda_1$  for  $y$ , and  $l_2$  and  $l_1$  for  $x$ .

Thus

$$(\lambda_2 - \lambda_1) \cot \gamma = \log (\tan l_2 + \sec l_2) - \log (\tan l_1 + \sec l_1).$$

The logarithms here are Napierian.

The right hand member may be written in other ways.

Thus we may write it

$$\log \frac{\tan l_2 + \sec l_2}{\tan l_1 + \sec l_1}$$

We shall thus have

$$(\lambda_2 - \lambda_1) \cot \gamma = \log \frac{\tan l_2 + \sec l_2}{\tan l_1 + \sec l_1} \quad (7)$$

We may also remember that if  $\beta$  be any angle

$$\tan \beta + \sec \beta = \frac{\sin \beta + 1}{\cos \beta}$$

$$\begin{aligned} &= \frac{\cos^2 \frac{\beta}{2} + \sin^2 \frac{\beta}{2} + 2 \sin \frac{\beta}{2} \cos \frac{\beta}{2}}{\cos^2 \frac{\beta}{2} - \sin^2 \frac{\beta}{2}} \\ &= \frac{(\cos \frac{\beta}{2} + \sin \frac{\beta}{2})}{\cos \frac{\beta}{2} - \sin \frac{\beta}{2}} \\ &= \tan \left( 45^\circ + \frac{\beta}{2} \right) \end{aligned}$$

Thus we may write

$$(\lambda_2 - \lambda_1) \cot \gamma = \log \frac{\tan \left( 45^\circ + \frac{l_2}{2} \right)}{\tan \left( 45^\circ + \frac{l_1}{2} \right)} \quad (8)$$

For analytical investigations we may use either (7) or (8). For numerical calculations (8) is the more convenient.

But for numerical calculations we may conveniently introduce common logarithms into our equation. And while doing so we may also express the longitudes in degrees.

Into the right hand member of (8) we must by the theory of logarithms introduce the factor  $p$  where  $p = 2.3026$  approximately. Into the left hand member we must

introduce the factor  $\frac{\pi}{180}$ . Thus (8) becomes

$$(\lambda_2^\circ - \lambda_1^\circ) \cot \gamma = \frac{180 p}{\pi} \log_{10} \frac{\tan \left( 45^\circ + \frac{l_2}{2} \right)}{\tan \left( 45^\circ + \frac{l_1}{2} \right)} \quad (9)$$

In our next paper we shall illustrate the use of (9) by some numerical examples.

#### NOTES FROM HOME.

(From our own Correspondent.)

THE disputes which have existed for some time between the Brighton and the South-Eastern Railway Companies are announced now to be at an end. The public being assured that agreements have been ratified between them by which peace is secured. This information will, no doubt, be heartily welcomed by the proprietors of both Companies, putting an end to a state of things which should never have found place in Railway administration, and which most seriously affected the prospects of both the Companies. The several managers will now be able to devote their entire energy to the development of their existing business and the improvement of their respective systems.

The contract for the main buildings of the Imperial Institute has been let to Messrs. Mowlen and Co. for £142,800, exclusive of the central, eastern and western towers, for which a subsequent contract has been taken by the same firm. The foundations for the main buildings were completed in May last at a cost of £6,000. It appears from the Report read at the recent meeting of the Organizing Committee, that the actual funds now available, exclusive of subscriptions from the Indian Empire and which are temporarily invested there, amount to £310,000.

The Manchester, Sheffield and Lincolnshire Railway Company again have had the misfortune to head the list of accidents, having had the most serious one that has occurred this year. In this case four persons have been killed owing to the breaking of an axle on a train running between Manchester and Guidebridge, and near the latter place. It appears that the train ran in this state about 500 yards and then came into collision with a goods engine. This distance should have been sufficient, had there been proper communication between passengers and guard, and an efficient automatic continuous break in use, to have pulled up the train.

The Municipal Engineers held their Annual Meeting in London at the Institution of Civil Engineers on three days of last week. It was the largest meeting of the Association that has ever been held. On this occasion the following papers were read: "Ten Years' Experience of the Shone's



System," by Colonel Jones, R.E.; "The Average Meter System" by G. R. Strachan; "Back Streets, Lanes and Alleys," by H. U. McKie; "Electric Firealarms," by T. De C. Meade, and "The Purification of Sewage by Electricity," by W. Webster, F.C.S.

Very interesting visits were paid to the Lucigen Light Works, where the process for the production of the light by the use of creosote oil, crude petroleum or over heavy hydrocarbons by means of compressed air in a special form of lamps, was shewn. The Oxygen Works and the New Battersea Bridge Works were also visited, and on the third day, the members proceeded down the river to inspect the works now in progress at the northern outfall at Barking. These works consist of precipitation tanks and sludge stores, from which the residue will be put on boardship and taken out some distance from the mouth of the river and there discharged.

Dr. Richardson, of "Hygieia celebrity," delivered an address entitled "the Storage of Life as a Sanitary Study" at the twelfth anniversary meeting of the Sanitary Institute of Great Britain, which was held last week at the Royal Institution at Albermarle Street, in which he urges the necessity of good sanitation and of observing the precepts of sanitary science as a great aid to the prolongation of life.

Professor Roscoe's Report on the deodorization of the London sewage has now been published. This document is received with a large amount of interest, as it has been looked upon as a suppressed criticism on the plan adopted by the Board in dealing with the sewage, as it is intended to do with chemicals at the new works at Barking. Sir Henry has arrived at the conclusion that the use of chemical deodorants ought to be regarded only as a temporary expedient, and that sooner or later the sewage must either be filtered through land or be discharged into the estuary at a point not higher than the sea reach.

## BURMA.

(From our own Correspondent.)

FROM the Burma State Railway Financial Accounts, just completed for the year 1887-88, we learn that the savings on the direct capital outlay is 5.24 per cent., and 5.16 per cent on capital charges, direct and indirect. The net earnings are given as Rs. 14,97,670, against Rs. 11,68,558 in 1886-87, and the net receipts Rs. 15,52,003, against Rs. 11,84,132 in the previous year. These favorable results are by no means attributable to the Railway Administration, but to the marked improvement of the traffic since the pacification of the country, and the large quantity of Government stores conveyed. The above items are only the outcome of traffic conducted on 333 miles of the open line.

So far these figures are very satisfactory, but for the grave error made in estimating the Budget Assignment. The original Budget Grant was estimated at Rs. 31,65,000, which amount was since revised to Rs. 33,00,000, and again further supplemented by Rs. 50,000. This objectionable difference of Rs. 1,85,000 certainly reflects discredit on the Railway Administration, more so when we learn that no special items are set down to any unforeseen expenditure.

At a special meeting recently held, comprising the principal Railway officials, and a select number of the leading merchants, it was decided that the Traffic Manual be revised, and the traffic rates be reduced on certain goods; advantage will also be taken of in improving certain rules and making the edition complete, so as to meet the requirements of the Mandalay extension.

In your issue of the 14th July an enquirer, "Hot Air," wants a description of a hot air engine, and the way it works. Perhaps the engine herein described will suit his purpose. Although there are many types of engines extant for the production of hot air, I believe that a more durable and economic apparatus does not exist than Gibb's Hot Air Cylinder and Drying Apparatus, now in use in one of the largest rice mills in this City. We are aware that perhaps in no place in India is the damp so lasting, and the effects so destructive as in Burma. The capabilities of this particular contrivance in keeping the spacious mill rooms, with enormous quantities of grain, quite dry, is a sufficient guarantee of its claim and usefulness in this direction. Unlike hot air engines, of which most are known, it is very simple. The cylinder is self-contained on a brick box constructed for the purpose, where coke is burnt: this box also serves the purpose as a flue, and takes in the waste heat from any operation carried on in the

vicinity. Aided by a compound wrought-iron fan which draws waste heat from a distance of 100 feet, the hot air passes along connecting tubes, on which are the smoke chimney and valve, and the thermometer and pyrometer, into the cylinder. In this instance there are two cylinders, each of 9 feet in length, connected by flanged rings (but we believe that they can be had to meet any requirement). From looking at the appliance it is quite patent that an adjuster or regulator, according to the quantity of heat required, is all the connection needed with the source of supply. This excellent appliance has been found to suit the multifarious requirements admirably, and has been in use for the past three years.

The engines of the S.S. *Rangoon* have become disabled, and she is now undergoing repairs at Dalla Dockyard. These repairs will only be of a temporary nature, to enable her to proceed to Calcutta to refit with new engines. The machinery, although old, might have served for some time to come; as from the nature of damage sustained, i.e., shrinkage of the boiler tubes causing excessive leakage, it would appear that the accident was caused by allowing the water in the boiler to run too low, and when in a heated state, cold water was pumped in, thus disabling the steaming power of the vessel.

The decided advantage of fitting sea going vessels with triple expansion engines, instead of compound and other types, has been most marked in the last trip of P. Henderson's regular liners to this port, S.S. *Irrawaddy*; she made the passage from the Clyde to Rangoon in 30 days, averaging a speed of 12½ knots per hour, the best record yet attained by the regular canal boats for this port. It is estimated that the consumption of coal was such as to show a saving of over 20 per cent. in fuel, besides economising extra space for cargo. The highest pressure the boiler can be worked up to, is limited at 150lbs., against 70 to 80lbs., the average maximum pressure worked by compound engines.

The I. M. stern wheeler *McIvor*, built by the Irrawaddy Flotilla Company, Limited, and fitted up expressly as a gun boat for service on the Chindwin, has returned much disabled, and is now being over-hauled at the Dalla Dockyard. Her machinery is of the old type of compound engines, and formerly belonged to one of the ex-King of Burma's steamers. This is the second time this vessel has been docked within the past year, on account of defects in her machinery.

Rangoon port is gradually looking up, two more iron swing jetties have been sanctioned; these when completed, with the anticipated improvements on a few of the old existing wooden pontoons, will complete the port requirements of this rising City. Already an allotment has been provided in the Budget Estimate for the ensuing year for lighting all the principal wharves with electric lights, and there appear to be no difficulties in this respect financially, as the Flotilla Company are now lighting the main wharf for only Rs. 750 per annum. Rangoon is certainly not far off being reckoned the first port in the East.

## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

Burma, August 4, 1888.

Mr. J. W. L. Tooza, Assistant Engineer, 1st grade, reported his return to duty on the forenoon of the 30th July 1888 from leave on medical certificate, the unexpired portion of which is hereby cancelled. Mr. Tooza's services are placed at the disposal of the Superintending Engineer, 2nd Circle.

Mr. F. W. Morse, Executive Engineer, 3rd grade, State Railways, temporarily transferred to Burma for employment on Provincial Works, reported his return to duty on the forenoon of the 19th August 1887. The unexpired portion of furlough granted in *Burma Gazette* Notification, dated the 15th December 1885, is hereby cancelled.

Madras, August 7, 1888.

The transfers of Mr. A. S. Russell, Executive Engineer, 3rd grade, sub., *pro tem.*, from the Tinnevely to No. II., Periyar Division, and of Mr. C. A. B. Target, Executive Engineer, 1st grade, from No. II., Periyar Division, to the North Arcot Division, notified in the *Fort St. George Gazette* of 31st July 1888, are hereby cancelled.

Mr. J. S. Wilson, Assistant Engineer, 1st grade, sub., *pro tem.*, passed on the 28th July 1888 the professional examination prescribed in para. 87 of the Public Works Department Code.

Under Section 128 of the Civil Leave Code, Sixth Edition, Mr. S. W. H. Ottmann, Honorary Assistant Engineer, 1st grade, is granted leave on medical certificate from 10th June 1888 to date of joining the Presidency Division.



The following transfer is ordered at the public expense :—  
M. R. Ry. T. Subrahmanya Pillai Avargal, Rai Bahadur, Honorary Assistant Engineer, 3rd grade, from the VI. Circle, Negapatam Division, to the V Circle, South Arcot Division, for duty on the Cuddalore Bridge works,

Punjab, August 9, 1888.

His Honour the Lieutenant-Governor is placed to sanction the following temporary promotion in the amalgamated Engineer Establishment of the General and Irrigation Branches of the Public Works Department, Punjab, with effect from the dates specified against each :—

Mr. F. W. Maunsell, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Major Jacob, R.E., appointed temporary Superintending Engineer, 3rd class, with effect from 18th April 1888.

Irrigation Branch.

Mr. O. V. Yates, Executive Engineer, 4th grade, from the Muzaffargarh Division, which he left on the afternoon of the 31st May 1888, to the Lower Sutlej and Chenab Division, Inundation Canals, which he joined on the forenoon of the 1st June 1888.

Mr. H. V. S. Baker, Executive Engineer, 3rd Grade, took over Executive charge of the Ferozepore Division, Sirhind Canal, from Mr. H. W. V. Colebrook, Executive Engineer, on the afternoon of the 16th July 1888; and the latter officer availed himself of the three months' privilege leave granted him in Irrigation Branch Memorandum dated 21st June 1888, from the afternoon of the same date.

N.-W. P. and Oudh, August 11, 1888.

Irrigation Branch.

Mr. C. Hill, Executive Engineer, 4th grade, sub. *pro tem.*, is appointed to the charge of the Agra Canal Division during the absence of Mr. C. G. Palmer, Executive Engineer, on privilege leave, or until further orders.

Buildings and Roads Branch.

Mr. W. B. Joyce, Overseer, 1st grade, temporary rank, Moradabad District, is posted to the Ballia District as Officiating District Engineer, or until further orders, *vice* Babu Battu Lall.

Central Provinces, August 11, 1888.

With reference to Notification, dated 5th ultimo, Mr. G. M. Harriott, Executive Engineer, availed himself of the privilege leave granted to him, on the forenoon of the 30th idem.

India, August 11, 1888.

Mr. R. A. Way, Executive Engineer, 2nd grade, State Railways, whose services have been temporarily placed at the disposal of the Bengal-Nagpur Railway Company, is granted special leave for three months on urgent private affairs under section 61 of the Civil Leave Code.

Mr. W. H. Nightingale, Executive Engineer, 1st grade, Bengal, is promoted to Superintending Engineer, 3rd class, temporary rank, *vice* Mr. G. A. D. Anley, proceeding on furlough.

Military Works Department.

Lieutenant G. S. Cartwright, R.E., is appointed to the Military Works Department, as a temporary Assistant Engineer, 2nd grade, for Special Defence Works, with effect from the 9th February 1888.

Assam, August 11, 1888.

Mr. Bolinarayan Borah, Executive-Engineer, 4th grade, temporary rank, who was appointed to hold temporary charge of the Central Assam Division during the absence on sick leave of Rai Bholanath Dass, Bahadur, Divisional Executive-Engineer, in Notification, dated 16th July 1888, received over charge of the Darrang district from Mr. T. H. Jewett, Executive-Engineer, on he afternoon of the 31st July 1888.

Mr. T. H. Jewett, C.E., Executive-Engineer, 3rd grade, who was appointed in Notification, dated 16th July 1888, to hold charge of the Khasi and Jaintia Hills Division, reported his arrival at Shillong on the afternoon of the 3rd August 1888, and received over charge of the Division and of the management of the Cherra-Companyganj State Railway from Mr. O. G. Smart, A.M.I.C.E., Executive-Engineer, on the afternoon of the 4th idem.

Bengal, August 15, 1888.

With reference to Government of India, Public Works Department Notification, dated the 6th instant, Mr. W. H. Nightingale is appointed to officiate as Superintending Engineer of the Eastern Circle, until further orders. Mr. Nightingale took up this appointment on the 11th of July 1888.

Mr. W. B. Bestie, Under-Secretary to the Government of Bengal, in the Public Works Department, is granted privilege leave for two months and nine days from the 20th instant, or such date as he may avail himself of it.

Mr. W. Connan, Inspector of Local Works in the Presidency Division, is appointed to officiate as Under-Secretary to the Government of Bengal, in the Public Works Department, during the absence, on leave, of Mr. W. B. Bestie, or until further orders

Mr. W. H. Nightingale, Officiating Superintending Engineer of the Eastern Circle, is appointed, under section 123 of the Bengal Local Self-Government Act, 1885, to be also Inspector of Local Works in the Presidency Division, during the absence, on deputation, of Mr. Connan, or until further orders.

Mr. C. H. DeMello, Assistant Engineer, is, on return from furlough, posted to the South-Western Circle.

P. W. D.  
CHITTAGONG DIVISION.

Tenders are invited for manufacturing and delivering the materials noted below. The Executive Engineer does not bind himself to accept the lowest or any tender.

NAME OF WORK.	Tender to be in Form No.	Amount of earnest money to accompany each tender.	Date and hour of opening tenders.	Date of commencement of delivery.	Date of completion of delivery.	Deposit money required to be paid by the successful tenderer	REMARKS.
Manufacturing and delivering at Chittagong for the Revenue and Judicial Courts and Offices at Fairy Hill. 300 Lacs of Table moulded and Pugged bricks to be delivered at the foot of Fairy Hill on Sites selected by the Executive Engineer.	P. W. D. Form No. 14 Supply of (materials.)	vide table of rates on the form quoted above.	5th September 1888. Wednesday (12 noon.)	Half before the 31st March 1889.	1st September 1889.	Ten per cent on the total value of the supply.	Particulars and specification can be seen— At the office of the Executive Engineer, 1st Calcutta Division. At the office of the Executive Engineer, Dacca Division. At the head office of the Chittagong Division (Chittagong.) Samples of materials required can be seen at Chittagong.

CHITTAGONG; }  
The 3rd August 1888

F. SILLS, C.E.,  
EXECUTIVE ENGINEER,  
Chittagong Division.



Advertisements.

PUBLIC WORKS DEPARTMENT.

REGISTRY OFFICE for Men of all grades  
out of employ is kept up by the—  
PRINCIPAL,

THOMASON COLLEGE,

ROORKEE.

(170)

NOTICE.

THE post of "Superintendent of Works,"  
Cooch Behar State, is filled up.

A. EVANS GORDON,

SUPERINTENDENT,

Cooch Behar State.

9th August 1888.

(178)

TIRHOOT STATE RAILWAY.

NOTICE.

TENDERS are invited for loading and unloading wagons  
at the Ganges Ferry of this Railway. Forms of tender  
may be obtained on application to this office after the 10th  
instant. Tenders should be addressed to Manager, and be in  
his office not later than noon on the 1st September 1888.  
Tenders must be sent in on the required form, or they will  
not be considered, and the cover of same should be super-  
scribed "Tender for Ferry Contract." The Manager does  
not bind himself to accept the lowest or any tender, or to  
give reasons for the rejection of a tender.

H. G. KUNHARDT, CAPT., R.E.,

Manager, T. S. R.

Mozufferpore ;  
The 10th August 1888. }

(177)

FOR SALE AT SIMLA.

TEAK TIMBER thoroughly seasoned, about 4,500  
cubic feet, mostly planks, 10-in. by 1½-in. and 5-in. by  
1½-in., at Rs. 4-2 per cubic foot.

Deodar Scantlings, 5-in. by 1-in.; 9-in. by 3½-in.; 9-in.  
by 7-in.; and 8-in. by 4-in., &c., &c., at Rs. 1-3-6 per cubic  
foot.

Staffordshire Iron Sheets, quite new, 7-ft. by 2-ft.  
9-in., at Rs. 10-11-0 per cwt.

Corrugated Iron Sheets, of various sizes, at Rs. 14-4-0  
per cwt.

A very large Stock of Brass and Iron Hinges, Locks,  
and other Door and Window Fittings, Paints and Var-  
nishes of various kinds; at cost prices.

Also some Portable Engines, Mortar Mills, Wood-  
working, and other Machinery.

Apply to the Executive Engineer, Simla Imperial Circle.

(Sd.) L. M. St. CLAIR,

Simla,  
28th July 1888. }

EX. ENGINEER,

Simla Imperial Circle.

NOW READY.

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P. W. D.  
CHITTAGONG DIVISION.

Tenders are invited for supplying the materials noted below. The Executive Engineer does not bind himself to accept the lowest or any tender.

NAME OF WORK.	Amount of Esti- mate excluding contingencies.	Tender to be in Form No.	Amount of ear- nest money to accompany each tender.	Date and hour of opening tenders.	Date of com- mencement of work.	Date of comple- tion of work.	Deposit-money required to be paid by the suc- cessful tenderer.	REMARKS.
25,000 maunds of first-class fresh Sylhet lime for the new Offices at Fairy Hill. The lime must be delivered unslaked suffi- cient to give the above quantity when slaked.	Nil.	14 M.	As per rates printed on the back of form No. 14 M.	20th August 1888 (noon).	1st October 1888 with an average monthly delivery of 2,000 maunds.	1st October 1889.	Rs. 10 per cent. on the total value.	The rate is to include slaking and the delivery of the lime at site of work on top of Fairy Hill at Chittagong. Another rate is also to be given if delivery is taken slaked in the store shed by the River Bank at Sunder- ghat, Chittagong. 100 maunds of slaked lime is to be taken as 225 c. ft. measured by tape.

CHITTAGONG :  
The 27th July 1888.

F. SILLS, C.E.,  
EXECUTIVE ENGINEER,  
Chittagong Division.

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Notice.

TO CONTRACTORS AND OTHERS.

For sale at the S. M. Railway Company Stores at Hubli.

- 10 Portable Engines, 10 H.-P.  
2 Portable Engines, 12 H.-P.  
Also the following Centrifugal and Contractors' Pumps :—  
5 eight-inch Centrifugal Pumps, "invincible."  
4 seven-inch Centrifugal Pumps, "invincible."  
16 six-inch Centrifugal Pumps, "Invincible."  
4 four-inch Contractors' Pumps.  
7 six inch Contractors' Pumps.  
1 six-and-a-half-inch Contractors' Pump.  
1 eight-and-a-quarter-inch Contractors' Pump.  
1 two-and-a-half-inch Contractors' Pump.

The Portable Engines and Pumps have all been in use, but they will be put into working order before being sent away.  
The Agent and Chief Engineer, S. M. Railway, Dharwar, is prepared to receive offers for any of the above.  
They are open to inspection to any one wanting them.

Apply to AGENT and CHIEF ENGINEER.

(173)

S. M. Railway-Dharwar.

NOTICE.

TENDERS are invited and will be received by the Undersigned up to the 31st August 1888 for the purchase of the Hull of the Government Iron Vessel "Cassandra" of 299 $\frac{2}{100}$  tons, Length 110 feet, Breadth 25 feet and Depth 13' 9".

The vessel is laying off the Salt Golah Moorings, Howrah.

For further particulars applications should be made to the Undersigned, who does not bind himself to accept the highest or any tender.

EATON W. PETLEY,

Offg. Port Officer of Calcutta

CALCUTTA PORT OFFICE ; }  
The 21st July 1888. }

(167)

A GREAT WANT SUPPLIED.

No Package Genuine without this Trade Mark.

TRADE MARK.

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(93)

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SILENT SELF-OILING PUMPKIN WHEEL  
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Price (reduced) if 20 or more are taken

These wheels are Noiseless and self-lubricating, do not drop oil or allow the rope to be pulled off them, are easily fixed in any position, answer equally well as Vertical or Horizontal wheels, and run perfectly for years without attention.

(154)

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CREAT WESTERN HOTEL,  
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[29]

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THOMSON & MYLNE'S  
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For particulars of Depots, Licensees, &c., address—  
THOMSON & MYLNE,  
BEHEEA, E. I. RAILWAY ;  
or 6, Commercial Buildings, Calcutta.  
(103)

BEST MIRZAPUR STONE.

The Mirzapur Stone and Trading Co., Cut-Stone Contractors and Quarryme Mirzapur, can supply—  
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And all descriptions of Cut-Stone. The cheapest in the market.  
Apply to the Company or to

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(158)

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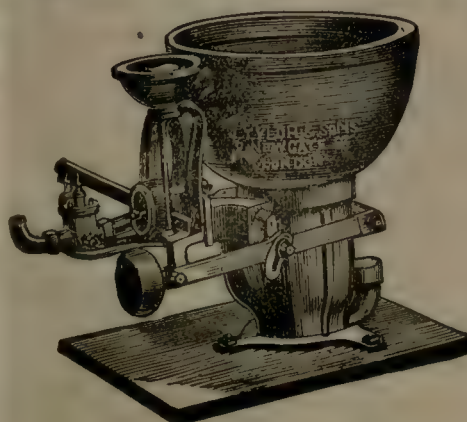
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J. D. JONES,  
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PROPRIETOR.

(108)



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Cast-iron Socket Pipes, of ordinary dimensions, coated with Dr. Angus Smith's solution, and tested up to a pressure of 250 feet of water	Rs. 4-4 per cwt.
Cast-iron Flange Pipes, of ordinary dimensions, tested up to a pressure of 250 feet of water, with faced joints and drilled bolt holes, coated with Dr. Angus Smith's solution	" 5-12 "
Cast-iron Bends, Tees and Cross Pieces for Pipings of ordinary dimensions coated with Dr. Angus Smith's solution	" 7-0 "
Cast-iron Fire-bars, Floor-plates, Plain Columns, &c., from	" 5-0 " upwards.
Cast-iron Railway Chairs and Railway Sleepers from	" 3-8 "
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Water-lifts ... from Rs. 35-0 each, and upwards.	Foundry Pig Iron No. 1 ... " 45-0 per ton.
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Remarks.—Special quotations for large orders. Designs of Ornamental Castings of any description can be had on application.  
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**GODOWNS:**—DACRE'S LANE.

(168)

*Telegraphic Address—"SILVERGRAY," CALCUTTA.*

## COMMERCIAL UNION ASSURANCE CO., LD.

*Extracts from the Twenty-sixth Annual Report viz. for the year 1887.*

### FIRE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£769,265 0 0
Interest ...	£ 18,612 0 0
Losses after deducting Re-insurances ..	£443,587 0 0

### LIFE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£125,559 0 0
Interest and Dividends ...	£ 45,649 0 0
Claims less Re-insurances, £	79,220 0 0

### MARINE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£175,118 0 0
Interest ...	£ 8,294 0 0
Losses after deducting Re-insurances ..	£138,365 0 0
Interest not belonging to above, but included in	
Profit and Loss ..	£ 18,545 0 0

The Life Fund was increased during the year by £265,648 and now amounts to £1,070,064.

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the uncalled Capital of £2,250,000.

The rates of Premium are moderate, but they are not unsafely low, and will be found to stand the test of time, thereby in conjunction with the ample Funds affording *absolute security* to the assured.

The Total Funds and property in hand on 31st December 1887 stood at £2,613,059.

(39)

C. H. OGBOURNE, *Manager and Underwriter.*

## PURE HYDRAULIC LIME. FREE FROM ADULTERATION.

Numerous favourable certificates of the quality of our manufacture have been received, and the following are fair selections:—

J. H. ARJOHN, Esq., Superintending Engineer, Kidderpore Dock Works, says:—

"Mr. McKennie's test for purity applied at Raneegeunge showed that it contained only 22 per cent. of insoluble matter, or only 3rds of the impurity allowed; there can be no question but that it is of very superior quality."

PAUL DEJOUX, Esq., Executive Engineer, Government Cement Experiment Division, reported:—

"It is the best Ghooting Lime imported into Calcutta."

JAMES KIMBER, Esq., M.I.O.E., Engineer to the Corporation of Calcutta, says:—

"It has been for long past and is now invariably used in all works, particularly drainage works. I have much pleasure in certifying to the excellent and reliable quality of the Lime."

C. A. MILLS, Esq., Executive Engineer, P. W. D., 2nd Calcutta Division, says:—

The Ghooting Lime manufactured by Messrs. Burn & Co. is better than any that can be purchased in Calcutta. I have used it in the construction of many public buildings and have been thoroughly satisfied with it."

N.B.—Our Lime was used throughout all the River Works of the Calcutta Port Commissioners.

## BURN & CO.,

7, Hastings Street, or Raneegeunge.



## Notices.

The Office of Publication of *Indian Engineering* is at the "STAR PRESS," 19, Lall Bazar, Calcutta.

General correspondence, and all communications bearing upon literary matters, should, as heretofore, be addressed to PAT. DOYLE, C.E., Spence's Hotel, Calcutta.

It is particularly requested that all letters on business concerning subscriptions and advertisements be addressed to the "Managing Agents," MESSRS. BALMER, LAWRIE & Co., 103, Clive Street, Calcutta; and all remittances be made payable to them.

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NOW READY.

## "Artesian Borings in the Sunderbunds."

As the issues of the journal containing the articles headed as above are out of print, and sufficient inducement having offered, the matter has been reproduced in pamphlet form to meet the requirements of District Officers and others in Bengal and elsewhere.

Price Rs. 2 per copy.—Cash.

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## Obituary.

PLUNKETT.—On 16th August at Bombay, James Henry, late Locomotive Department, G. I. P. Railway.

# INDIAN ENGINEERING.

SATURDAY, AUGUST 25, 1888.

### AN INSTITUTE OF ENGINEERS.

It has always seemed strange to us that in a country like India where Engineering skill is so largely employed, and where the service consists of men who would be an ornament to the profession in any part of the world, there is no Engineers' Association, which might be made the medium of free interchange of thoughts and ideas. Such an institution would certainly tend to the progress and development of the science and practice of Engineering, and form a focus for the reception and diffusion of technical knowledge. It would answer other purposes as well, such as establishing good-will and fraternity among its members, and promoting an organisation among the units in the service, which, for want of such an arrangement, lie scattered throughout the country and do not constitute a "force." Besides what golden opportunities would be presented for the discussion of abstruse points connected with a world-wide subject as Engineering.

We have been led to offer these remarks on perusing a little pamphlet entitled the "Transactions of the Indian Engineers' Association" for the half-year ending June 1871. It appears to have been inaugurated by a body of native professional gentlemen with the object as suggested above. Before this period two attempts were made to form a nucleus of such an institution—one known as "Engineers' Dinner" was started by Colonel J. P. Beadle, Chief Engineer in Bengal, about a quarter of a century ago, with the view, we presume, of bringing together the members of the service at the festive board, where, after the cloth was removed, instead of trying a chance at whist or a game of billiards, they would employ their time more profitably in discussing professional topics. The other was a proposal in the "Calcutta Engineers' Journal," a few years later, to have an institute on the lines of the Institute of Civil Engineers at home; but nothing came of either. As our acquaintance with Calcutta does not extend so far back as 1862 or 1867, we say what has been told to us that the first did not succeed owing to its exclusiveness, and the latter to want of unity and *esprit de corps* among the officers of the Public Works Department.

The third attempt was made in the beginning of 1870, when, a question of forming an Association being raised among some of the European and native Engineers residing in town, a preliminary meeting was held in February of that year for taking into consideration the feasibility of the project, at which a code of rules was framed for circulation among the members of the profession with the object of gauging their opinion in regard to it. Everything was arranged to the satisfaction of the meeting; a programme was drawn up embodying the outlines of the proposed Association and a code of rules which were despatched all over the country to Engineers as well as others con-



needed with the profession, requesting them to offer suggestions as to the best mode of carrying out the objects of the Association. It need hardly be said that eighteen years ago there did not exist facilities for communication as are available now, and only 35 responses were received. As larger co-operation was necessary to start such a scheme, and to conduct it in a suitable manner the formal inauguration of the Association had, as might have been expected under the circumstances, to be deferred. There were other difficulties to contend with. The well-known scientist, Dr. Mohendra Lall Sircar, of Calcutta, was about this time engaged working out the details of a Science Association which is to-day an accomplished fact, and it was proposed to him to incorporate with it the Engineers' Association. But as the former was not formally organised, the question had to be deferred. Bombay threw cold water on the scheme, for when co-operation was asked the reply received was that they had there a similar institution of their own, and of course much assistance could not be expected from that quarter, though that was just the reason why they should have helped at the birth of the Association. However, the Calcutta Engineers accepted *nil desperandum* as their motto, and at a meeting held on the 10th November 1870, it was found that 50 persons had responded to the invitation, and were willing to join. This was considered a decent number to start with, and operations were commenced forthwith. Secretaries and a Treasurer were appointed at a meeting held on the 9th December, and the office of President was left vacant to be filled up the following year by some one of the many experienced European Engineers in Calcutta, who would sympathise with, and take active interest in, the movement.

With these preliminaries the Association was launched so far with prospects of success. On a cursory glance at the pamphlet we find that its contents are not confined to Engineering proper, but embrace a wider field of knowledge. A paper on the laterites of the District of Bancoorah shews that eighteen years ago professional men did not utilise this useful stone for building purposes, and that while they procured materials from Burrakur, Chunar, and even from England, they neglected such a useful substance lying in quarries within 86 miles of Calcutta, and in close proximity to the East Indian Railway. There are some instructive notes on brick-making evidently written by one who had made it a subject of special study. A brief history of the steam engine must have been a welcome contribution to the junior members of the service, especially overseers and their assistants, as it is a subject which then did not form part of their education. Major (now General) Trevor's formula for calculating the breadth of foundation is the subject of a short paper by a native gentleman. Besides the above, there are in the pamphlet a good many interesting selections from professional papers, which of themselves make good reading. That such an Association would, after an existence of a few years, have answered its purpose we have no doubt, and regret that it should have

collapsed before it had emerged out of its swaddling clothes. But as there exist greater facilities at the present day for organising such an institution, we see no reason why steps should not be adopted to bring about such a desirable result. So far as we are concerned, we promise every assistance that lies in our power to secure its stability.

#### THE CANADIAN-PACIFIC RAILWAY.

THERE is an impression amongst Englishmen who think, and have faculty for thinking, and some regard for Imperial interests, that an alternative route to India as a surplusage to Suez Canal adaptabilities for transport eastwards is not only desirable, but imperative.

The idea is not a new one; it has been discussed, advocated, combated, for the last fifty years. Forty years ago that shrewd, genial Nova Scotian Colonist who made genial pretence of being half a Yankee, and christened himself Sam Slick wrote:—

"This great national highway from the Atlantic to the Pacific is the great link which is required to unite in one powerful chain the whole English race; which will be the means of enabling vessels steaming from our magnificent Colonies, from New Zealand, Van Diemen's Land, New South Wales, New Holland, from Borneo and the West Coast of China, from the Sandwich Islands, and a thousand other places, all carrying the rich productions of the East, to land them at the commencement of the West."

Sam Slick's advocacy availed not in his own time. It was in 1871 that the idea gathered to itself form and shape, coherency and consistency. The first survey party having in view discovery of a practicable route commenced operations in June of that year. Very little was practically done, however, till 1881. Then a company was initiated for completion of an all rail route across the Continent to the Pacific Coast. It contracted to do the work it had undertaken by the 1st of May 1891. As a matter of fact, however, what had to be done was done—and well done—finished, *totus* and *teres*—in December 1885, six years ahead of the contract that is to say. It would be impertinent to assume that the Superintending Engineers who had the giving away of the contracts were drivelling idiots. A more pleasant, as well as more reasonable belief to take is, that they were possessed of very praiseworthy stocks of energy, enterprize, and *savoir faire*.

The Railway is the shortest of the three great trans-continental highways, the distance from Montreal to Vancouver being 600 miles less than from New York to San Francisco, and the distance from Liverpool to China and Japan, *via* the Canadian Pacific Railway, is shortened by about 1,000 miles. The line's construction cost Canada about twenty-four million pounds sterling. Those much blessed Canadians! They have no depreciated rupees and unsolvable currency problems to bother them! Perhaps that is why they manage to get their Railway lines finished so much more quickly than we can.



By way of exemplar and moral, and somewhat of brag too perhaps, it has been written as to this line :—"The completion of the Railway has in a measure *altered the natural position* of Canada, because it provides her with access to the Pacific Ocean, and consequently a position in the markets of China, Japan, Australasia, and South America, which she has never previously enjoyed, and which promises a new era of commercial prosperity to the dominion." The Eastern Provinces are rapidly becoming manufacturing centres; and there is room and foundation for belief that a vast field lies open in this direction in British Columbia.

That almost virginal territory abounds in coal and iron supplies, any amount of timber and sufficiency of water-power to render working these resources comparatively easy. Slow vessels are at present running between Vancouver and Hong-Kong, *via* Yokohama, but we are told that a "new, regular and fast service will probably be established in 1889."

Meanwhile, although every province in the dominion has had sea-board connection, it is beginning to be felt that Manitoba and British Columbia have been somewhat neglected. They were new; and United States powers are not *quite* almighty.

It is said to be not unlikely that, before very long, there will be a direct line of steamers established between British Columbia and Australia. Our author hints that there are many other Imperial considerations connected with the Canadian-Pacific route, which deserve mention. Notably, to this tune :—It has generally been felt, and the opinion has received forcible expression during the last few months, that in time of war it would be impossible to rely upon the Suez Canal route as a regular means of communication with the East. The Cape route is no doubt a valuable one; but the difficulties of coaling on the way would, it is said, seriously impair its value not only for commercial purposes, but especially for the conveyance of troops and warlike material in time of war. None of these disadvantages can be said to apply to the Canadian-Pacific route. The North Atlantic could certainly be pretty well patrolled and controlled by Great Britain, and the line from Halifax or Quebec is entirely through British territory. Then again there are abundant supplies of coal at Halifax and also at Vancouver; therefore with steamers crossing to China and Japan and to Australasia, with a speed hitherto unknown on the Pacific Ocean, we have a route as safe and secure as it is possible for any route to be, and upon which the speed can be guaranteed. Therefore the statement is justified, I think, that troops and munitions of war could be sent *via* Canada to China and Japan, and Australasia, more safely and probably quicker than by any other way. Besides, if Halifax and Vancouver, in anticipation of any difficulty, were made into *places d'armes*, as in the case of Malta and Cyprus in recent years, bodies of troops could be conveyed from those places to India in a comparatively short time. It is to be hoped that such contingencies may never occur, but it is very necessary in these times to bear them in mind.

Since we do not care to afflict ourselves with Imperial concerns whilst other men are paid to look after them, we may just as well conclude now. The distance from Vancouver to Calcutta is 9,010 miles.

#### PRIZE DAY AT COOPER'S HILL.

THE last English mail brought an account of the gathering and doings at Cooper's Hill last Prize Day (25th July). Everything seems to have gone off most pleasantly and successfully, even a doubtful English climate proving propitious to the occasion. Sir John Fowler, a past President of the Institution of Civil Engineers, made the prize distribution, a function at which almost all the distinguished Anglo-Indians now in London seem to have assisted.

Sir Alexander Taylor's report on the working of the College was an eminently satisfactory one. He commenced by drawing attention to the fact that, during the last few years, the Institution has increased largely, both in the number of its scholars, and the scope of its work. In September 1882 there were 90 scholars: in September 1887 there were 139. During the period included between these two dates, the teaching staff of the College has been nearly doubled. A forestry branch has been added to the educational course; and has brought in its train three other new subjects—botany, organic chemistry, and entomology, to wit. Moreover, for Forest students, annual tours of inspection to forests in Great Britain and in the Continent are now organized. And, says Sir Alexander Taylor, "we do a large part of the chemical testing of metals, India-rubber, paints, varnishes, &c., required in connection with contracts under execution in this country, for the Government of India, as well as, I believe, the whole of the mechanical testing of metals and chains required in the same connection."

It is not only in these matters that progress has been made. All friends of the College will rejoice to hear that its income has expanded; that the year's receipts fully covered the year's outlay; that its enemies do not seem likely to have any further chance of grumbling about its upkeep as an irritating unwarrantable burden on Indian tax-payers. Here is an extract from the President's speech, which has a certain statistical interest likely to commend it to our readers:—

"There are to-day 127 students, of whom 39 having completed their College course, leave this afternoon. The 39 comprise 27 Engineer, 2 Telegraph and 10 Forest students. I will take them in order and will begin with the 27 Engineer students. It is a great gratification to me to be able to say that the majority of these men have put into their work an amount of 'go' and 'backbone' that really leaves very little to be desired in this direction. I strongly desire to speak of them in terms of very hearty commendation. And I am glad to explain the grounds for my good opinion. I have two sources of information. The one, our own experience, and the other the reports of the special examiners, gentlemen entirely independent of the College, who have recently had these students under examination. Our own opinion



is based on solid data. We have had each of these senior students under instruction for three years, and we have pumped his brains some 95 times with all the thoroughness we have been able to bring to bear, with the result that we think the senior year is a very unusually good one. And the reports of the independent examiners are to the effect that while there is not a single subject in which these students have not come up to the average of former years, in the great majority of subjects they have done very decidedly better. The mark sheets shew that the top man, Clayton, has made 83 per cent. of possible marks—a figure that has been reached only once before in the experience of the College. They also shew that the last man who wins an appointment to India—Baines (I may mention his name as I am about to praise him)—has made 59 per cent. of total possible marks: a figure that has never before on any occasion been reached by a man in his position; and that the last man who receives a College diploma of qualification has made 40 per cent., which is a higher percentage than has ever before been made. I can thus confidently say, and I do it with the greatest pleasure, and speaking both from our own experience and from the reports of the outside examiners, that out of the 16 sets of students who have gone out from Cooper's Hill in years past into the Public Service, there are very few indeed that have more distinguished themselves than has the set of Engineer students that leaves us this afternoon."

Dr. Schlich is well pleased with the progress made by Forest students. Last year, Mr. Rogers, a distinguished student in this Department, made 78 per cent. of possible marks, and received a special scholarship from the Indian Council, in token of appreciation of his merit.

This year his record has been surpassed by Mr. Ormiston, who scored 80 per cent. There are but few subjects which Forest and Engineer students take up on precisely the same platform, but this year, a Forest man, Mr. Monro, was first in Physics.

Sir Alexander Taylor told the Engineer students remaining in the College, that they will have to make a good struggle if they mean to reach the standard attained by their seniors now leaving. Fellowships were conferred on Messrs. Clayton, Bell and Dupuis. The latter gentleman is one of the best lawn-tennis players at the College, where athletic sports continue to be encouraged by the teaching staff, and are prosecuted with vigor by their scholars who, by the way, still continue to form "O" Company of the Berkshire Volunteers. A strong company of 116 rank and file—all of them efficient.

We note that Sir Alexander Taylor offers his report as "a brief record of a successful Sessions' work."

**TEHUANTEPEC SHIP RAILWAY.**—A contract for Captain Eads proposed ship railway across the isthmus of Tehuantepec from the Mexican Gulf to the Pacific has been recently let. The work is to be completed, according to present arrangements, in five years.

**NICARAGUA INTEROCEANIC CANAL.**—The survey of the Nicaragua Interoceanic Canal route is now nearly completed. The line which will probably be adopted is substantially the same, it is said, as that indicated by the preliminary reconnaissance made in 1885, the changes being slight. The excavation required will, it is now stated, be less than had been supposed.

## Notes and Comments.

**ART EXHIBITION OF POONA.**—The subscriptions in aid of the ensuing Native Industrial Art Exhibition of Poona are coming in apace.

**DALLA DOCKYARD.**—The Irrawaddy Flotilla Company have been very fortunate in obtaining a lease of the Government Dalla Dockyard for 10 years at Rs. 3,000 per month.

**W. OF I. PORTUGUESE RAILWAY.**—After much discussion the Portuguese Parliament has voted the amount of £50,000, which the West of India Portuguese Railway Company has already spent for the Marmagoa harbour and the Railway line.

**A SURVEY FOR A NEW RAILWAY LINE.**—It has been arranged to make a regular survey, with accurate estimates, of the Chanda and Raipore lines before a final decision is arrived at as to which line shall be made. This will probably take about two years.

**CHITTAGONG DIVISION, P. W. D., BENGAL.**—We have been favored with copies of the printed specifications, with list of tools and plant, for manufacturing the bricks required for the new public offices at Chittagong, and shall be glad to furnish the same to parties desirous of tendering for the work.

**SWEDISH IRON FOR INDIA.**—The Swedish Iron Masters' Association has at the suggestion of the Board of Directors of the Swedish Export Association, assigned the sum of 7,500 kroners for the purpose of sending out an agent to travel in India and China to endeavour to push the sale of Swedish iron and manufactures.

**BURMA STATE RAILWAY.**—The Traffic Superintendent of this Railway has had to advertise in the Madras papers for men to take up the appointment of Station Masters on the Mandalay Extension, as he could not get any from Bengal. The open line staff on this Railway are too expensive, and the Government of India has called for a reduction.

**THE PROPOSED HOOGHLY TUNNEL.**—We learn that Mr. W. Duff Bruce's plans have been prepared for this project, and the scheme will be shortly submitted to the Secretary of State—the borings alone being the delaying factor. The experimental borings in connection with the proposed subway shew good results. The soil is said to be well suited for the purpose.

**PUDUKOTA P. W. D. BUDGET.**—The figures in the Estimate for the year 1888-89—are for *Irrigation* Rs. 16,000 or 2·31 per cent. of the total expenditure, and for *Civil Works* the proposed outlay is thus distributed: Town Conservancy Rs. 10,000, Roads Rs. 35,000, Buildings Rs. 75,000, Establishments Rs. 24,000—making a total of Rs. 1,44,000 or 20·81 of the whole estimate. This looks satisfactory.

**THE LIGHT-HOUSES OFF THE COAST OF BURMA.**—We glean from the Report on the light-houses and light-vessels off the coast of Burma for the year 1887-88, that the buildings are in good order, and the lighting apparatus well looked after. No accidents or disasters occurred at any of the light-houses during the year. The expenditure under all heads, inclusive of Public Works, amounted to Rs. 1,17,434, or Rs. 5,426 more than in the previous year.

**THE MADRAS PIER.**—The Engineer of the Madras Harbour Trust Board, having submitted a supplementary estimate for repairing the ironwork of the Madras Screw Pile Pier, amounting to Rs. 52,736, in addition to the estimate



of Rs. 29,881 already sanctioned, the Board resolved that the Engineer be requested to prepare an estimate for such repairs only as are absolutely necessary to keep the pier in working order for the next five years, bearing in mind the increased weight of the steam cranes which it is proposed to erect.

**CEYLON RAILWAYS.**—The Haputale Railway Extension is to be carried out departmentally, but no officers of the P. W. D. are to be employed by Mr. Waring, whose staff will be made up as follows:—Resident Engineer, Mr. Waring; District Engineers, Messrs Oliver, Stables, Mackintosh and Lelievre; Assistant Engineers, Messrs. Pease, Floyer, Craig, Cockshot and Church; Accountant, Mr. Root; Storekeeper, Mr. Duff. The Colonial Government will endeavour to import the required labor from the Coast of India.

**LIGHTNING CONDUCTORS.**—We have been favored with a copy of the Instructions issued by the R. E. Department on the application of Lightning Conductors. We reserve our comments on the subject for some future issue. But we may say that the fact is all our arrangements of that kind were and are empirical, and in the light of the most recent experiments we must consider our present methods defective. The rules in the pamphlet are just taken from ordinary books, only there is the usual military affectation of precision.

**THE GOVERNMENT AND THE PRESS.**—The *Poona Observer* writes:—Some time ago we had a few remarks to make on the injustice done to Mr. Pat. Doyle, C.E., the well-known proprietor and Editor of *INDIAN ENGINEERING*, by the action taken by Government in practically subsidising a rival professional journal. We are glad to find that our opinion as regards the invidious nature of the transaction is shared by a Calcutta journal, the *Indian Daily News*. We gave the views of the Calcutta paper in our last issue.

**COMPARATIVE COST OF CINCHONA PRODUCTION.**—The attention of the Government of India having been invited by the Secretary of State to the circumstance that bark which in Bengal costs Government  $5\frac{1}{4}$  annas per pound is not produced in the Nilgiri Plantations for less than  $10\frac{1}{4}$  annas, the Madras Government consider, in explanation, that the comparison made by the Bengal Government between the cost of Cinchona-bark grown on the Madras Plantations and those of Bengal is based on data so dissimilar as to render it unreliable and misleading.

**ITEMS FROM CHINA.**—The Yellow River has come with all the force of the summer freshet and swept away the barriers interposed at the gap of last September. The money and energy expended during the last nine months at Cheng-chow have been thrown away and the whole question has now to be reconsidered.—The erection of a bridge across the Peiho at Tiensin by the Railway Company has at last been decided upon. The bridge is to be placed on the French Concession, as the French protested against having same placed below the French Consulate, because it would involve inconvenience to gunboats coming up to the French bund.

**SHERGHUR COMPANY.**—The balance sheet of this promising speculation is unique: the paid-up capital is Rs. 10,000, and there are debts of Rs. 3,186. The assets are put down at:—Expended on developing mining rights, Rs. 7,802; value of mining rights in Jograd and Kapasarah, Rs. 5,084; tools, &c., Rs. 300—total Rs. 13,186. This is the interesting concern part

of which was to have been sold to the Raneeegunge Coal Association for 4 lakhs of rupees; and which they declined to buy. It is understood that the Managing Director, Mr. A. E. Harriss, has gone to England, presumably to seek "fresh woods and pastures new."

**BOMBAY VERSUS LANCASHIRE.**—A Bombay paper says that an English firm of machinists have orders in their books to equip sixteen new mills in India, and "at the present time there are no less than twenty-five mills being prepared in Bombay, while in Lancashire the growth of the home industry is represented by the erection of a solitary mill." But somebody thinks that the writer must mean Japan. At present Japan is putting up a multitude of tiny mills, 3,000 to 5,000 spindles each, and 25 of such would only equal two mills of the average Indian size. The same critic observes that five new mills are going up in Bombay, not 25 as this writer says.

**A DARK OUTLOOK.**—The fall of the dollar to three shillings, and the prospect of further decline, present a dark outlook, the only apparently bright spot being the likelihood of the adoption of bi-metallism. Silver has been of late produced at rates undreamt of a few years back, and likely to be lower still ere long. The Broken Hill mines in Australia are turning out the metal in quantities, that bid fair to make it cheaper than ever. A whole mountain there is said to be one mass of pure silver. The metal can be cut out of its sides in blocks with a pickaxe. Should silver become too cheap, plentiful and common, of which there is every chance, it will hardly be of much use as standard of currency. The fixed ratio of the bi-metallists will become illusory at once.

**EMBANKMENTS IN BENGAL.**—The grant for the maintenance of embankments for the year 1886-87 was—Government embankments Rs. 5,31,000, Tuccavee embankments Rs. 1,32,000—total Rs. 6,63,000. The expenditure was as follows:—Government embankments Rs. 5,45,436, Tuccavee embankments Rs. 84,340—total Rs. 6,29,776. Those classed as tuccavee are maintained at the cost of zemindars, either under contract for a fixed term of years, or under annual estimates for repairs. The average rate for the maintenance of 1,184 miles of Government embankments is Rs. 245.47, or Rs. 35.47 more than that of the previous year, an excess chiefly due to the increased expenditure on account of repairs of heavy damages from the floods of the previous year. For tuccavee embankments under contract, the average rate is Rs. 156, or Rs. 10 below that for last year.

**MESSRS. NEILSON'S ENGINES for HEAVY INCLINES.**—Some people have got rather mixed in their ideas of the new locomotives being sent out to work the heavy inclines on the Sind Peshin and Bolan Railways. It would be but a poor performance for an engine weighing 128 tons to only take 70 tons up an incline of 1 in 15 but two miles long. Messrs. Neilson and Co. have sent out two different descriptions of engines for heavy inclines—one an eight-wheeled coupled tank engine with *inside* cylinders for Kojak works, weighing in steam 58 tons and capable of taking a train of 70 tons exclusive of engine up inclines of 1 in 15. The other a twin engine consisting of two separate six-wheeled coupled engines with one tender between them weighing in all 124 tons, from the designs of Mr. C. Sandiford, Locomotive Superintendent N. W. Railway, Lahore, calculated to take a train weighing over 300 tons up long gradients of 1 in 40.

**LOCAL FUND WORKS IN THE MADRAS PRESIDENCY.**—The Government of India observe that the amount devoted



to local public works in the Madras Presidency during the year 1886-87 was Rs. 28,81,810. The suggestion of the Finance Committee, that all local public works should be carried out by the Imperial Public Works Department, having been referred to, the views adopted by the Government of India in this matter are stated in a Home Department Resolution, dated 10th February 1888; and under the terms of that Resolution it is in the power of the local Government to retain the execution of works paid for by local bodies in the hands of such bodies. This arrangement has been adopted by the Government of Madras, and to its adoption the Government of India raises no objection, but the Governor-General in Council trusts, however, that the operation of the plan will be carefully watched by the local Government.

**THE ROYAL MILITARY ACADEMY.**—The Duke of Cambridge awarded commissions in the Royal Artillery and Royal Engineers to the successful cadets at the Royal Military Academy, Woolwich, on the 26th July. General R. J. Hay, Governor of the Academy, reported that the acceleration of the Academy course had afforded an opportunity of advancement which the cadets had not neglected, they having worked well to compass within three terms the work of four, and thereby quite justified the step which had been taken. Their conduct also had been excellent. The fifty-four cadets of the examination class were called forward to receive her Majesty's commissions, 16 being for the Royal Engineers. The Duke of Cambridge, addressing the cadets, congratulated them upon the effort which enabled them to rise to the emergency in which they were placed. He urged them to continue their studies, in order not only to keep abreast of science, but to compare well with other nations.

**H. DEAR AND COMPANY, LIMITED.**—This is the name of a Company which has been recently registered with a capital of 6 lakhs, in shares of Rs. 100 each. The object of the Company is to acquire the good-will of the late business of Herschell Dear and Company, of Monghyr, and more particularly to carry on the trade in timber, from which it is well known that during the last ten years the late Mr. Dear derived an income averaging 1½ lakhs per annum. The Company acquire the lease of the Ramnuggur forest for 8 years at an annual rent of Rs. 8,500, which has hitherto been worked by Messrs. H. Dear and Company. Messrs. Gillanders, Arbuthnot and Company become the Managing Agents on a commission of 2 per cent. on all timber sold to Government or the Indian Railways, and 7 per cent. on all other sales. Mr. C. T. Ambler becomes the Superintendent on a salary of Rs. 800 per month and 10 per cent. on the net profits, and Mr. F. H. Murray, the Manager of the Forest Department, on Rs. 350.

**UNNECESSARY INTERFERENCE.**—*Appropos* of the proposed Factory Act for Bombay, a Parsee writes pertinently to the *Times of India*:—In matters of private enterprise, like the cotton mills of Bombay, Government might well refrain from playing the despot, and from all unnecessary interference with the private rights of the people. If the mill-owners and their laborers are well satisfied with the present state of things, and if the one or the other of them do not desire to have any kind of legislation regarding their own affairs and private interests, it would surely be wiser and better on the part of Government to steer a middle course or to remain perfectly neutral in the matter. I have reason to believe that more men have died or are dying

every year from hunger and starvation than from hard work or over-work. It is nothing short of maudlin sentimentality or officious philanthropy to make laws as regards a class of men who are quite able and willing to work harder and longer, so long as they are liberally paid for it, and have nothing to say against it.

**SPECIAL RULES FOR THE RETIREMENT OF OFFICERS OF THE INDIAN TELEGRAPH DEPARTMENT.**—The practical application of the special retirement rules for the Indian Telegraph Department, which were promulgated in the Government of India Resolution, dated 21st October 1887, has shewn that they produced some anomalies, and that their effect has been less favorable than was anticipated, when the Resolution was published, to the officers whose position it was desired to benefit. The Governor-General in Council is pleased to issue, with the sanction of the Secretary of State, other rules, which are supplementary to the rules in the Resolution referred to. The following appears to us to be the most important of the *new* rules:—Any officer of the Indian Telegraph Department who had less than 20 years' service counting for pension on the 31st March 1888, will be eligible to retire from the Department when he attains to 20 years' pensionable service, with the pension due to him under the rules in force (on medical certificate or otherwise), together with an extra pension of Rs. 1,000 per annum.

**JAIL INDUSTRIES.**—The *Times of India* says that the principle that convicts should be made to contribute as much as possible towards their own maintenance has unquestionably much to be said for it. Aimless labor, mere treadmill work or shot drill, has little or nothing that can be advanced in its favor, though in the case of short sentences it is difficult to see how anything else can be substituted. But it is an unquestionable and very serious result of jail labor that it enters, and has an increasing tendency to enter, into competition with private enterprise. Moreover, it is open to doubt whether many of the occupations to which prisoners are set are really punitive and deterrent. We now find jails in the Punjab and all over India entering into competition with private firms for Government contracts. In the Punjab we find the following branches of manufacture:—Carpets, durries, weaving cotton, lithographic printing paper making, rope making, ice manufacture, and "miscellaneous." Now, this list suggests two questions: first, how much of the work is really hard labor? and, second, how far does it compete, and on exceptionally favored conditions compete, with private enterprise?

**A PITIABLE FAILURE.**—M. de Lesseps' Panama Canal scheme is very nearly played out. If he only ruined himself by his vain imaginings it would not matter much. But it is pitiable to think of the many families in rural France that will be reduced to beggary as a result of their faith in France's Grand Old Man. The pity of it is that these grand old men are (unconsciously to themselves, it may well be) most intensely selfish, as well as superbly self-opinionated; and under colorable pretext of generous instincts, they do infinite harm in the world. Who was the abortive duffer in Lempriere's Classical Dictionary, who essayed scaling the outside edge of the universe, or a nefarious attack on the virtue of Hera—or some such attempt at a lark—and for his pains got chained to a rock without any cushions, or even moral supports? French capitalists don't seem inclined to give M. de Lesseps any more cushions. He was emphatically and



entirely a creation, an outcome of Napoleonism. And that *régime* is dead; and so is his capability for raising money on the Bourse. We take it that, in Yankee parlance, the Panama Canal speculation is "played out." It would be utter waste of time to ask to see the cards used. M. de Lesseps, like Mr. Gladstone, has a convenient genius for forgetting and ignoring facts.

**THE DELHI-KALKA RAILWAY.**—The *Indian Daily News* writes:—"We referred some time since to the Railway promoted by Mr. Duff Bruce, Mr. J. J. Keswick, Mr. Robert Miller, and their friends, and which will actually be a new chord line to the East Indian Railway, *vid* Delhi and Umballa to Kalka. The Secretary of State has given a concession for 25 years, and the line is to be worked by the East Indian Railway Company for 48 per cent. of the gross revenue. These terms are most favorable, and the scheme would have been launched ere this, if there had not been some delay in arranging the contract terms for working the line with the East Indian Railway, who for a long time stood out for 50 per cent. As it is, the prospectus will probably be placed on the market in October. Mr. Duff Bruce has applied for an extension of leave for four months, prior probably to his resignation, as he is to be the Consulting Engineer to the Company in England. Mr. R. A. Way, who was associated with Mr. T. R. Wynne, the present Chief Engineer of the Bengal-Nagpore line, on construction work on various lines, is to be the Chief Engineer of the line in India, another feather in the cap of the Cooper's Hill men. This grant of the line in connection with the East Indian Railway is a severe rebuff to the Royal Engineer clique in England, who were exerting all their influence to get the concession in connection with the Bombay and Baroda Railway." This statement, however, of our generally well-informed contemporary requires confirmation.

**MINING IN INDIA.**—The lengths which self-interest will induce some people to go is appalling when exemplified by a recent assertion in the correspondence columns of a leading Calcutta "daily," where the startling statement is made that the Indian coal-mines with an output of 2,300,000 tons per annum employ 200,000 people. If a cypher were omitted, the figure would be more near the truth. The number of persons employed in the mines of the United Kingdom was 503,987 in 1882 and 514,933 in 1883, when the production was 156,499,997 and 163,737,327 tons, respectively. In respect to accidents, it is unquestionable that as regards India these are few and far between. Ball in his "Manual"—published by the Government of India—says of the Raniganj field that "accidents, particularly those accompanied by loss of life, are of rare occurrence," and adds that "none of the mines are of great depth, and a perfect freedom from fire and choke damp render it possible to carry on the work without its being necessary to adopt the precautions which in England only fail too often to secure the object aimed at." We may say that it was not till 1843, after the mining industry had been in existence and in active operation for 550 years, that the Home Government appointed the first Inspector. In that year the total annual output of the mines of the United Kingdom was 43,000,000. The Indian output is something like 2,000,000 tons per annum, and some of the mines are hundreds, while others are more than a thousand miles apart. Under these circumstances, we consider that the Executive are wise in letting well alone.

## Current News.

THE *Straits Times* says that a large brewery and distillery are being erected in Johore.

CONSIDERABLE damage has been done to the Sone Canal head-works. The broken piers are now being repaired.

THE rainfall to date has been insufficient in several parts of the Bombay Presidency, as well as of the Punjab and Bengal.

THERE was no truth in the rumour that the Himalayan Railway had been breached during a recent storm. The line is intact.

THE project for an East Coast Railway from Calcutta to Bezwada is meeting with warm approval in all the districts which would be tapped by the line.

THE major portion of the Public Works Secretariat will be left behind at Simla this winter, only a camp office going down for the season to Calcutta.

THE line of Railway from Bezwada to the frontier of His Highness the Nizam's Dominions will in future be styled the Bezwada Extension Railway.

CAPTAIN H. D. LOVE, Principal of the College of Civil Engineering, has been granted by the Secretary of State for India an extension of furlough for two months.

MR. JOHN ELIOT, Officiating Meteorological Reporter to the Government of India, who has been on tour in Bombay and Bengal, returns to duty at Simla next week.

MAJOR CARTER, R.E., Inspector of Submarine Defences in India, died at Bombay on Monday. The deceased was a zealous and efficient officer, and was well known in Calcutta.

MR. F. B. HANNA, M.A., Agent and Manager of the Madras Railway, and President of the Faculty of Civil Engineering in the University of Madras, has been appointed a Trustee of the Madras Harbour Board.

MR. PEDLER has written an interesting report on the Meteorological Department of the Government of Bengal. He records the important changes, introduced during the year 1887-88, to improve the working of the Department.

THE Ceylon Spinning and Weaving Company is now fairly started, and the directors having secured Rs. 400,000 of the proposed capital, have purchased a block of land at Wellewatta, in the south of Colombo, on which to erect their mills.

THE Government of India has definitely refused to make over to the Calcutta Corporation the Howrah Bridge surplus for the construction of the Central Road. It is a mistake to suppose that the East Indian Railway ever advanced any claim to the money; all it did was to oppose the use of it for the road scheme.

MACHINE guns are shortly to be provided for the coast defences. The Government of India has sanctioned twelve for Bombay, seven for the Hooghly, eight each for Kurrachee and Rangoon and nine for Madras, or 44 in all. The three Presidencies together with Quetta are to have 85 machine guns for the land defences.

COLONEL WALLACE, R.E., on his arrival at Simla, does not act at once for Colonel Conway-Gordon; but he will do so later on. There appears no doubt that Colonel Conway-Gordon ought, for the sake of his health, to take leave, in spite of his desire to remain at his post. It is almost certain that he will have to do so ultimately.

THE whole management of the North-Western Railway will shortly undergo considerable alteration. The entire line will be brought under one management, thus doing away with what is now known as the Sind Section. The head-quarters will remain at Lahore, but the office will be considerably enlarged: while the terminus at Kurrachee will become an important charge.

THERE is some prospect of a good water-supply for Murree. There are two schemes under consideration. The first is to pump up water from Kuldunna and Clifden to the top of Pinnacle Hill, where it will be stored in tanks and distributed throughout the station through pipes. The second, is to carry it to the top of Pinnacle Hill from the top of the hill on which Dunga Gali is built—a distance of about 19 miles by the road.



## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*

### PENSIONS AND RETIREMENTS.

SIR.—Your correspondents "Q." and "Trebar" will find the information they ask for in your issue of 4th August, in the P. W. D. classified list published by the *Indian Daily News*.

X.

### "MERIT LEADING TO DISTINCTION."

SIR.—On his new wheels Mr. Proctor Sims seems likely to be even more of an ornament to the profession of Engineering than hitherto his special cult has permitted. A veritable embodiment of economy he has doubled up half-a-dozen State appointments at Bhowmuggur in his own person, and is now, according to a paragraph in your last issue, not only State Engineer, but also Public Works Minister, Municipal Chairman, Justice of the Quorum, and Head Secretary—but also "Every thing else of public utility to the State," the chief of which "respects him as a father." The only parallel instance of like success is that of Colonel Jacob at Jeyapore, whose name is inseparably associated with the progress of that well-known Rajpootana State, and as Colonel Jacob also belongs to the profession of Engineering, I consider that his name ought to have found a place in your paragraph in preference to those given.

RAJPUT.

### GOVERNMENT OF INDIA VERSUS "INDIAN ENGINEERING."

SIR.—I have just read your letter "To the Profession in India," sent with your number for 28th July, and venture to write to you, in spite of my very insignificant position in the P. W. D. list, in order to thank you for what you have already done towards giving us an impartial journal. I sincerely hope that the very fact of your having been unjustly treated (with regard to your rival) by our paternal Government, will induce more of us, both R.E. and C.E., in the P. W. D., to stand by you. It is well-known that a journal which speaks up fearlessly, without bias, and above all, with a view to great care and accuracy in its statements, is a most desirable thing for the members of our profession in India in this age of kow-towing to our bosses. They have tried to make you take a back seat, but I feel sure you will keep your place and will force yourself more and more into prominence by maintaining, without bearing malice, a fearless and outspoken policy.

A. E.

### BUILDING SOCIETIES.

SIR.—I am at a loss to account for the absence of a Building Society from the number of institutions which have sprung up in Calcutta, and especially because there is a large and stationary section of comparatively ill-paid men who never have a decent abode. It may be that, owing to the high value of land, the difficulties were great, but when the suburbs amalgamation scheme is in operation, a fine opportunity will be presented to those philanthropically disposed to initiate a society of this kind, in order that, even the lower classes, by being industrious and thrifty, may be able to provide themselves with a home of their own, and become citizens of a more useful and intelligent kind. There is nothing that makes or mars a man in life so much as the condition and surroundings of his home; and, apart from many other considerations, it would be quite right and proper for the City Fathers to support and encourage any scheme intended to better the home life of the people entrusted to their care.

Now is the time to move, so that when the suburbs are amalgamated, the first chance is not lost of securing good sites for building. Should a society be formed, and proper and earnest representatives elected to form a committee, I have no doubt they would obtain very material help from gentlemen interested in the improvement of the poorer classes.

SELF-HELP.

[There are many such Associations in Southern India, and something like a half-dozen of them in Madras.—Ed., I. E.]

### ANGLO-INDIAN ENGINEERS.

SIR.—Colonel Lawrie has published a second series of sketches of distinguished Anglo-Indians. The book contains 361 pages, is padded with irrelevant notices of Lord Byron, the Prince of Wales' pageant at Benares, the story of Sir Roper Lethbridge's successes, and a vast amount of twaddle. But the only Indian Engineer it makes any mention at all of is—Lieutenant-General Richard Strachey, R.E.—Guilford Molesworth, Bradford Leslie, and a dozen other Anglo-Indian Engineers who have scored their triumphs in India, are all left out in the cold. Perhaps they won't mind much if they take Colonel Lawrie's way of illustrating character into consideration. Of General Strachey, we are told for instance

that "if he wishes for controversy, he can find it from day to day in the Government Meteorological Office, of which he is the chief." One knows, and is allowed to know, so little about India Office Stores, that I was not aware before of a special Jupiter Pluvius being kept on the premises.

By way of commentary, and haply amendment of some doll-house Engineering architecture of a bye-gone time, I quote the following passage—the Jumma Masjid and the Taj Mehal being the text:—"It is painful to turn from these grand edifices to the Railway station, which, though well and solidly constructed of red sandstone, presents to the eye a hideous mixture of Eastern and Western styles—Norman towers and Indian minarets—the gateway of a county jail, with the architrave of a Hindoo temple—a fortress without, and a booking office within!"

VINDEK.

### NEW TECHNICAL COLLEGE AT SYDNEY, N. S. W.

SIR.—At the present moment, when technical education is a subject of special interest, it might be interesting to note how the Colony of New South Wales has seen its way to supply this want. The Colonial Government first of all deputed a specially qualified officer to make an exhaustive enquiry into the methods of training adopted in Europe and America, and having received his report, inaugurated a system of technical education under State control, and appointed a Board to superintend its operations.

The immediate result of this policy was the establishment of the Sydney Technical College, with the following twelve departments:—

1. Agriculture, including botany, veterinary science, and wood-sorting.
2. Applied mechanics, including mechanical drawing, naval architecture, boiler-making and turning and fitting.
3. Architecture, including carpentry and joinery, masonry, bricklaying, plumbing, cabinet-making and carriage-building.
4. Art, including geometry, perspective, model and freehand drawing, design and house painting and decorating.
5. Geology, including mining, mineralogy, and physiography.
6. Chemistry, including laboratory instruction in practical and theoretical chemistry, metallurgy, and photography.
7. Commercial economy, including French, German, Latin, phonography, advanced caligraphy, correspondence and book-keeping.
8. Mathematics, including navigation and actuarial science.
9. Elocution, including the art of public speaking and reciting.
10. Pharmacy, including materia medica, pharmacy, therapeutics, anatomy, physiology and dentistry.
11. Physics, including optics, sound and other branches of natural philosophy, practical electricity and telegraphy.
12. Domestic economy, including cookery and household management.

As regards other classes, there is a rule which provides that instruction will be given in any special subject, whenever, at least, 12 intending students send a requisition to the Principal asking for such instruction.

An important feature of the scheme of technical education in N. S. W. consists in the arranging for itinerant lecturers, so that less favored towns may derive a certain amount of benefit and maintain classes for imparting technical knowledge.

ADVANCE INDIA!

### THE WESTERN BENGAL RAILWAY AND THE COAL-FIELDS OF "SONTHALIA."

SIR.—In your paper of the 11th August 1888, I observe that Sir Bradford Leslie, in writing about the Western Bengal Railway project, makes no mention of the vast coal-fields of the Dominikoh, in the Sonthal Pergunnahs, and the country west, compared to which the whole of the coal mines of Raneeungee, Burrakur, Girdii, &c., are of smaller area.

The Bhagulpore-Nonee Haut branch of the Western Bengal Railway project will run through the western section of this coal country, and if judiciously laid out, it may serve the great mountain belt of coal on the east, as well as the coal beds on the west.

As I explored and worked the coal of these parts for about 5 to 7 years, I send you a descriptive outline of this country.

The distance between the East Indian Railway Loop Line and the Bhagulpore-Nonee Haut project, as shewn on your map, is about 48 miles. I explored this country from north to south for about 50 miles, marking the sites of coal out-crops, &c. I will begin by dividing it into four sections.

Section 1.—The eastern. The coal formation in this section dips from the Ganges towards the west, attaining its greatest depth below the surface about 5 miles west of the East Indian Railway Loop Line, and 15 miles further west it crops up above the ground, and was worked by me for the East Indian Railway Company in the Goomanee Valley. It forms a great trough of coal; its greatest breadth to the Ganges is about 30 miles, to the East Indian Railway 20 miles, and its length may be 80 miles, but I only explored 60 miles as noted above.

The two great outlets from this tract of hill country are down



the Goomanee Valley and the Banslowe Valley, which are about 20 miles apart, and cross the East Indian Railway Loop Line.

These valleys supplied the East Indian Railway Company with coal between 1856 and 1860, or 1862.

In the Goomanee Valley, the first or upper bed was composed of 6 feet of coal shale and 16 feet of good coal; the second bed was composed of 12 feet of coal; the sandstone on the first bed was 30 to 40 feet in thickness; on the second bed 30 feet in thickness; below these there was about 100 feet of coal sandstone, with thin layers of inferior coal and iron ore.

The first bed was a low crop—coal below the ground. The second coal bed was a high crop out of the hill, the floor of the coal bed being nearly on a level with the ground. Both were worked for many years without any machinery. The coal was used for brick burning and for getting up steam in the ballast engines, &c., before the line was opened to the Ganges. As these mines required a branch line from the East Indian Railway to compete with Raneeunge, &c., and the expense of carting was much greater than the cost by rail, they had to be closed, but now that the State is constructing Railways north of the Ganges, the quantity of coal required, and the saving of 1½ anna per maund to Government, may induce them to open out the country by a branch Railway.

The area of No. 1 Section is about 1,500 square miles. The greatest depth, is about 800 feet, but as the 3 miles of crop I worked may give 40 lakhs of maunds for 80 years, the deep coal may not be touched for a long time.

Section 2.—The Hill Section is about 6 miles broad. The coal ascends to about 5 or 700 feet, shewing its highest crop on the west of the Dominikoh Hills. About one-half of the coal has been cut away by the formation, or scooping out of the valleys, but about 150 square miles of coal formation remains.

Section 3.—This is west of the Dominikoh, the coal being above ground was swept away, and maunds of coal ashes and sandstone may be found resting on the gneiss formation.

Section 4.—Here the coal formation dips west below the surface in or about the place marked for the Bhagulpore Nonee-Haut project, and it will be evident that if the B. and N. Railway is judiciously laid out, with suitable branches, many coal companies may start in the hills on the east, and in the country west, and sufficient coal obtained to make the Western Bengal Railway project as paying as the East Indian Railway; for I have been informed that it is the East Indian Railway coal that makes their Railway so profitable. The quantity of coal obtainable from the coal-fields west of the B. N. project is uncertain, but this is not the case with the Hill Section, where the quantity is inexhaustible. A branch run down the Goomanee would compete with the East Indian Railway for a portion of the great beds of No. 1 Section; the distance from both Railways is about equal.

In another letter I will enter into details, and shew that the Goomanee Valley will be able to undersell all other coal mines at present working by 1½ anna per maund when supplying the Railways north of the Ganges, the steamers on the Ganges, &c., &c.

As the Western Bengal Railway will have as short a lead as the East Indian Railway Chord Line, competition will be equal.

P. BURKE.

CALCUTTA; August 18, 1888.

## Literary Notices.

THE CLYDE FROM ITS SOURCE TO THE SEA. By W. J. Millar, C.E., Secretary of the Institution of Engineers and Ship-builders in Scotland. Edinburgh:—Blackie & Son. 1888.

This work has for its object to present in a condensed form a complete general view of the River in all its relations; to trace its connection with the rise and progress of Marine Engineering and Ship-building; and to describe the various topographical, geological, meteorological, historical, and industrial features of the Clyde Valley.

The Topographical section contains a full account of the Clyde and all its tributaries, illustrated by an excellent plan and section of the river and the firth.

The Historical associations connected with the River and its immediate neighbourhood have been carefully treated. This is particularly the case in that section which deals with the City of Glasgow. Here the ancient city and its wonderful modern development are contrasted in an interesting and instructive manner. The causes and conditions, in virtue of which Glasgow has reached its present greatness, have been traced with admirable clearness, and the whole modern life of the city is presented with succinct completeness.

The Industrial and Commercial aspects of the River have received chief attention, and the rapid expansion of Glasgow as a

mercantile centre gets its main illustration in the section which treats of ship-building and engineering. Here the author has brought together a unique mass of interesting information regarding the first developments of steam shipping on the Clyde and the earlier efforts of the ship-building firms who have made the river famous. In this connection a facsimile of the original draft of the first steam-boat the *Comet*, built at Port-Glasgow for Henry Bell by John Wood, is here given for the first time as an interesting historical relic.

Besides the commercial and industrial aspects of the Clyde, its Defences, Yachting, Lighthouses, &c., have received special attention.

The Illustrations form an attractive feature in the book, which is elegantly bound in cloth. Various places of interest from the Falls of Clyde to Ailsa Craig have been illustrated, and portraits of such men as Telford, Henry Bell, John Robertson, and Robert Napier have been carefully reproduced.

## New Books and Reprints.

### ART AND ARCHITECTURE.

- ARCHITECT'S Register (The): Being a Publication Devoted to Art, Architecture, Engineering, Building and Matters pertaining thereto. Established to form the Nucleus of a Register of Papers read before Architectural and kindred Societies throughout the United Kingdom, compiled as a Book of Reference for the Use of Architects, Engineers, Builders, Contractors and those interested in Art and Building Matters Generally. Vol. 3. Cr. 8vo, pp. 170. Pope ... 2/6
- LIPPMANN (F.) The Art of Wood Engraving in Italy in the Fifteenth Century. Imp. 8vo. Quaritch ... 25/
- ROBINSON (H. P.) Letters on Landscape Photography. (Photographic Handy-Books, No. 9.) 12mo, sd., pp. 66. Piper and Carter ... 1/
- SHARPE (Edwin) The Seven Periods of English Architecture. Defined and Illust. with Twenty-three Engravings and Woodcuts. 3rd ed. Roy. 8vo. Spon's ... 12/6

### CHEMISTRY AND PHYSICS.

- AVELING (Edward) Mechanics and Experimental Science, as required for the Examination of the University of London. Key to Chemistry. Post 8vo, pp. 50. Chapman ... 3/6
- CHURCH (Arthur Herbert) The Laboratory Guide: A Manual of Practical Chemistry for Colleges and Schools. Specially Arranged for Agricultural Students. 6th ed., revised and enlarged. Post 8vo, pp. 290. Gurney and Jackson ... 6/6
- COOK (Ernest H.) Introductory Inorganic Analysis: A First Course of Chemical Testing. Post 8vo, pp. 44. Churchill ... 1/6
- KOLBE (H.) Short Text Book of Inorganic Chemistry. Trans. and edit. by T. S. Humpidge. With a Coloured Plate of Spectra, and numerous Wood Engravings. 2nd ed., revised. Post 8vo, pp. 610. Longmans ... 7/6
- STEWART (B.) An Elementary Treatise on Heat. 5th ed. Post 8vo, pp. 438. Frowde ... 7/6
- VALENTIN (Wm. Geo.) A Course of Qualitative Chemical Analysis. 7th ed. Edit. and Revised by Dr. W. R. Hodgkinson, Assisted by H. Chapman Jones and F. E. Matthews. 8vo, pp. 306. Churchill ... 8/6
- VOGEL (Hermann) The Chemistry of Light and Photography in their Application to Art, Science and Industry. With 100 Illusts. 5th ed. (International Scientific Series.) Post 8vo, pp. 300. Paul, Trench and Co. ... 5/

### ENGINEERING AND MECHANICS.

- AVELING (E.) Mechanics and Experimental Science, as required for the Matriculation Examination of the University of London. Key to Mechanics. Post 8vo pp. 116. Chapman ... 3/6
- BIDDLE (Tyrrel E.) Hints on Yacht Building for Amateurs. 8vo, sd. pp. 44. G. Wilson ... 2/
- CALVERT'S Practical Notes on Screw-Cutting. With examples, Formulas on Fractional, Decimal, Diametral, Millimetre and Rifle Pitches; Various Tables of Change, Wheels for  $\frac{1}{2}$ ,  $\frac{1}{4}$ ,  $\frac{3}{8}$ ,  $\frac{1}{2}$  and  $\frac{3}{4}$  inch Pitch Guide Screws; Notes on Screw-Cutting Tools, Illustrated with tables and Information Useful to Turners and Fitters. By William Ward. 32mo, pp. 132. Calvert (Manchester). Simpkin ... 2/6
- COLLINS (J. H.) A First Book of Mining and Quarrying. With the Science Connected therewith, for Use in Primary Schools and Self-Instruction. With numerous Illusts. 2nd ed., revised with additions (Weale's Elementary Series, 264) Cr. 8vo, pp. 126. Lockwood ... 1/6
- GRIEVE (W. H.) Lessons in Elementary Mechanics, Specially adapted to the Requirements of the Revised New Code, Stage 2. 12mo. pp. 146. Longmans ... 1/6
- HASLUCK (Paul N.) The Mechanic's Workshop Handy-book: A Practical Manual of Mechanical Manipulation, Embracing Information of Various Handicraft Processes. With Useful Notes and Miscellaneous Memoranda. Post 8vo, pp. 136. Lockwood ... 2/
- HERING (C.) Principles of Dynamo-Electric Machines. With Direction for Designing and Constructing Dynamos, Appendix of Articles on Allied Subjects and Table of Equivalents of Units of Measurement. Cr. 8vo. Spon's ... 10/6
- MACFARLANE (J. W.) Practical Notes on Pipe Founding. 8vo. Spon's ... 12/6
- WHEELER (W. H.) Drainage of Fens and Low Lands by Gravitation and Steam Power. 8vo. Spon's ... 12/6
- WILSON (Fred. J. F.) and Grey (Douglas) A Practical Treatise upon Modern Printing Machinery and Letterpress Printing. Illust. with numerous Engravings Roy. 8vo. pp. 444. Cassell ... 21



# General Articles.

## TYPES OF IRON GIRDER BRIDGES, INDIAN MIDLAND RAILWAY.

THE girders of the Jumna Bridge at Kalpi were designed by Sir. A. M. Rendel, the Consulting Engineer to the India Office. The general design of the bridge itself was prepared by Major Gracey, R.E., Mr. H. L. Monk being the Executive Engineer in charge of its construction. The girders were erected by Mr. G. H. Bayly, Contractor, who was formerly a District Engineer in the service of the B. B. and C. I. Railway. The piers are built to a height of 76' above low-water mark and are made for a double road-way, the rails being laid between the girders. The bridge consists of 10 spans of 250'.

The design by Mr. G. Berkley, the Company's Consulting Engineer, for the 250' span over the deep water channel of the Ken Bridge, differs widely from the girders of the Jumna Bridge. The girders of this bridge are not yet erected.

The bridge over the Betwa at Sujanpura near Jhansi is 90' high, and consists of one span of 60' and 13 spans of 150', the roadway being carried between the girders. The top chord or boom consists of two side plates braced together top and bottom, and the lower boom of 2 plates 15" deep and  $\frac{5}{8}$ " thick at the ends, the central portions having an extra thickness of plate rivetted to each of them. The depth of the girders from centre to centre of chords or booms is 19' 8", and the clear width of roadway 15' 0", giving a centre to centre distance of girders of 16' 6". The batter or end strut being wider at the bottom than at the top the lower chord plates kink inwards to the first vertical. The cross girders are suspended from the vertical struts and the roadway is covered with corrugated iron plates to fit it in case of necessity for the passage of Artillery. All large through bridges of this Railway are similarly provided with roadways.

The bridge across the Betwa at Makrari, 25 miles from Jhansi, is a similar structure and consists of 9 spans of 150'—56' high, so also are the Bhina and Narrain Bridges between Bhopal and Jhansi, each consisting of 4 spans of 150'—67' and 54' high respectively.

Of the same type of girders are the bridges over the Sindh River—10 spans of 100' on the Gwalior-Jhansi Section; the Keotan—5 spans of 100' and Betwa Bridge near Bhilsa—4 spans of 100' and 5 spans of 75', all from 50' to 65' feet high. The vertical struts in these spans are battered downwards from the top on the outside to stiffen them, but the batter braces or end struts are not raked or battered as in the 150' spans.

All girders for this Railway are made of steel and are manufactured by various makers, but McLellan's, the Hasford Company and Westword Bailie's work have all been finished with commendable accuracy.

The weights of the several girders are approximately as follows :—

	tons.	cwt.
75 feet span through bridge	64	15 per span.
100 " " do.	81	5 "
100 " " decked	66	5 "
120 " " do.	110	6 "
150 " " through bridge	133	6 "
250 " " do.	318	4 Jumna Bridge.
250 " " do.	Not known yet Ken Bridge.	

The following Table shews the maximum tensile and compressive strains in the girders of the bridges of the spans referred :—

BRIDGE.	BOOMS.		WEBS.		CROSS AND RAIL GIRDERS.	
	Maxim. Tensile.	Maxim. Compressive.	Maxim. Tensile.	Maxim. Compressive.	Maxim. Tensile.	Maxim. Compressive.
75 feet through span	4.55	3.2	2	2.5	5	4.5
100 " " do.	5.9	3.9	4.06	2.3	5	4.5
100 " " deck span	4.65	4.9	4.35	2.5		
120 " " do.	4.85	3.9	3.9	2.5	4.2	3.9
150 " " through span	6.3	4.15	5.75	2.71	5	5
250 " " do.						
(Jumna Bridge)	6.2	6.0	6.4	3.56	6.4	5.0

All bearing parts are steel.

The cross and Rail girders are all designed for an axle load of 16 tons, and wind is in every case calculated at 56lbs. per square inch against the structure and 35lbs. against the structure and train.

Details of the main girders of these Bridges will be furnished in a Series of Plates to be published in subsequent issues of INDIAN ENGINEERING.

## NOTES ON NAVIGATION.

By A. EWBANK.

V.

OUR equation for the course  $\gamma$  was

$$(\lambda_2 - \lambda_1) \cot \gamma = \frac{180}{\pi} p \log \frac{\tan \left( 45 + \frac{l_1}{2} \right)}{\tan \left( 45 + \frac{l_2}{2} \right)} \quad (9)$$

$$\frac{180}{\pi} p = 131.93 \text{ approximately}$$

$$\log \frac{180}{\pi} p = 2.1203401 \text{ approximately}$$

M is a point in the equator. We draw a rhumb line which shall start from M and have  $\gamma = 5^\circ$ . It is required to find how many spiral turns will be necessary in order to reach the north pole.

Let  $n$  turns be necessary. Then

$$\lambda_2 - \lambda_1 = 360n$$

$$l_2 = 90^\circ$$

$$l_1 = 0^\circ$$

$$\tan \left( 45 + \frac{l_2}{2} \right) = \tan 90^\circ = \text{infinity}$$

$$\therefore \log \tan \left( 45 + \frac{l_2}{2} \right) = \text{infinity}$$

$$\log \tan \left( 45 + \frac{l_1}{2} \right) = 0$$

$$360n \cot 5^\circ = \frac{180}{\pi} p \{ \text{infinity} \}$$

$\therefore n$  is infinite.

This conclusion we had in our general reasonings anticipated.

A and B are the points having equal latitudes and unequal longitudes. In this case the right hand member of (9) vanishes, because  $\log 1 = 0$ .

And  $\lambda_2 - \lambda_1$  is not zero

$$\therefore \cot \gamma = 0$$

$$\therefore \gamma = 90^\circ$$

In other words, the rhumb line becomes a small circle of latitude.

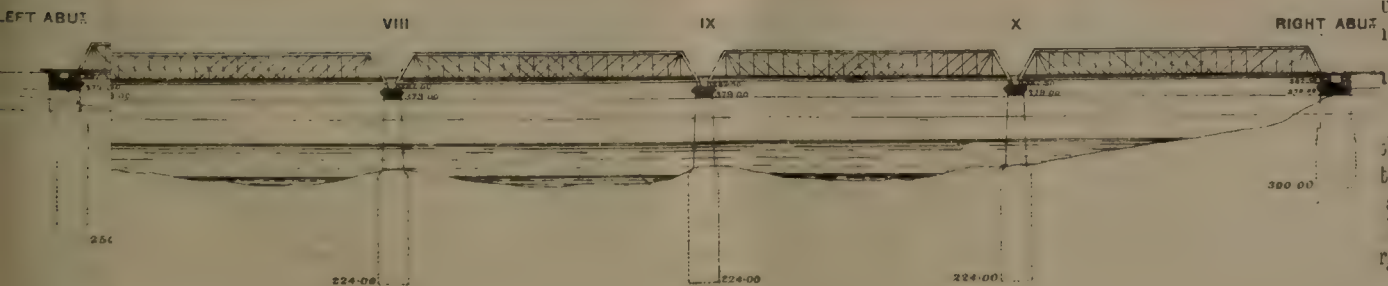
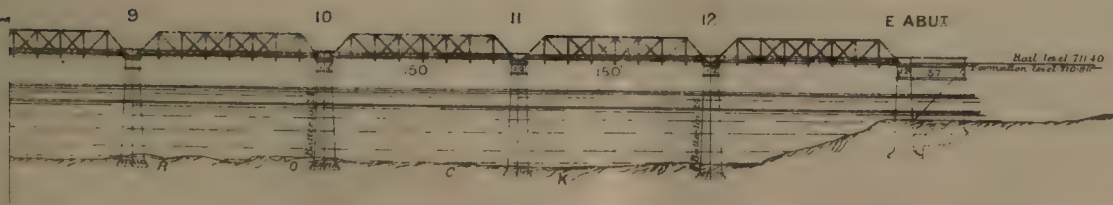
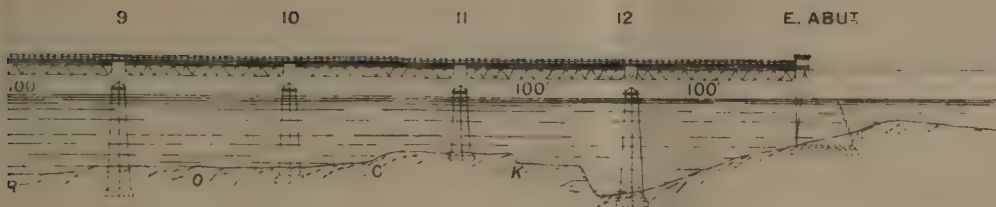
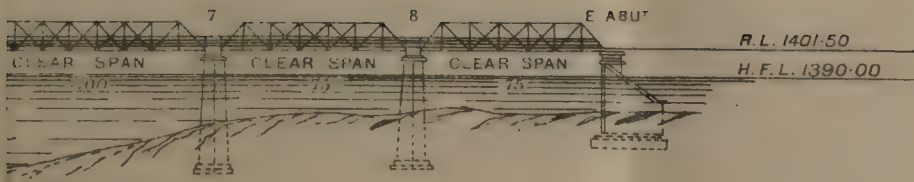
Let A and B be in the same meridian, and have different latitudes. Then  $\lambda_2 - \lambda_1 = 0$ , and as the right hand member of (9) has some finite value, we must have  $\cot \gamma = \text{infinity}$ . Thus  $\gamma = 0^\circ$ , or the meridian itself is the rhumb line.

If this conclusion—dealing with infinities—seems doubtful to the reader, we may approach the question in another way.

Let A and B have latitudes which are appreciably different. Let their longitudes differ by an extremely small quantity. Then the right hand member of (9) has some finite value. But one factor of the left hand member, viz., the factor  $\lambda_2 - \lambda_1$  is extremely small. Thus the other factor, viz.,  $\cot \gamma$  must be extremely large. Therefore  $\gamma$  must be an exceedingly small angle. In the extreme limit  $\lambda_2 - \lambda_1$  becomes zero, and  $\gamma$  also becomes zero.

Thus we see that equation (9) properly questioned yields us complete information respecting the changes in the rhumb line with changes in the relative positions of the points A and B, between which it has to be drawn.







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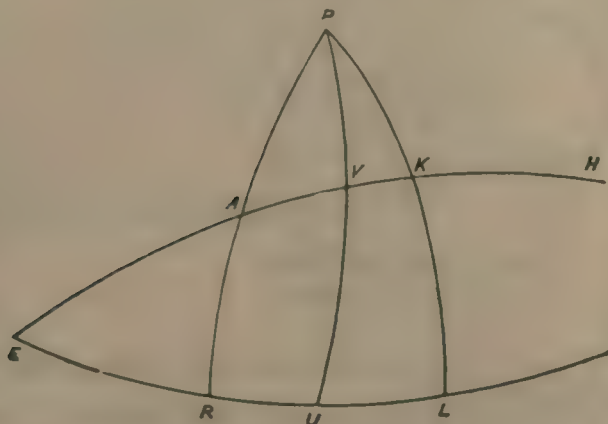
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Fig. 11.



But, instead of making the numerical calculations, let us, as in *fig. 11*, cause the arc of  $10^\circ$  to slide little further, so that  $V$  shall be its middle point. Here  $AV = VK = 5^\circ$ . Then we know that  $\gamma$  will be  $90^\circ$ . The circle course at  $A = PAH$ . The circle course at  $K = PKH$ . These angles are supplementary, and so their semi-sum is exactly  $\gamma$ .

We see then that as an arc of  $10^\circ$  slides along the great circle  $EV$ , the quantity  $\gamma$ , which initially is less than  $0005$  or  $\frac{1}{2,000}$ , becomes ultimately zero.

We may therefore be sure that for the arc  $AV$  of *fig. 10*, the value of  $\gamma$  is very small.

And in the two cases where we had obtained a numerical value for  $\gamma$ , the rhumb line course was less than the semi-sum of the circle courses. Apart, therefore, from any further evidence, the expectation will be that the rhumb line course is always less than the semi-sum of the circle courses, except where the difference completely vanishes.

#### SITE PLAN OF THE MADRAS NEW HIGH COURT.

THE accompanying is the site plan of the new High Court buildings, Madras, finally decided upon after a controversy extending to about five years.

The first site selected was on what is locally known as the Pudupet plain—a truly splendid position and worthy of some grand creation. The bar and bench were quite in favor of it, but being far away from the business portion of the city, the merchants, tradesmen, and general public, opposed it and suggested the site now adopted. This site forms a sort of out-work or glacis of the old Fort, and is thus under military control, and General Roberts, our then Commander-in-Chief, refused to alienate it for any other purpose. In this dilemma the Government suggested half-a-dozen other different sites, all of which were very commendable, but to which the bench and bar, the merchants or the general public, took some vital objection, but all agreed in this one point, that the site now selected would be the best, if the objections of the *militaire* could be overcome. Any collision between the common people and the autocratic sons of Mars generally terminates in the triumph of the sword, and if India is governed with or by bayonets, as our Russian friends would make the world believe, here was a case where the military would have ridden rough shod over the wishes of the people; but, strange inconsistency, after an exchange of showers of paper bullets and many cuts with pasteboard swords, the pretensions of the fire-eating military were quietly withdrawn, and the wishes of the civil population were acceded to. Who will not say after this that the wolf and the lamb do not feed together, and the lion eat straw like the ox, at least in India, especially when the very strong wishes and opinions of England's second General were calmly discussed and withdrawn in favor of the desires of the population of a third-rate Indian city. I wonder if Russia and the world will be convinced after this, that the legitimate wishes of its people, and not English bayonets, governs this splendid Empire. Little

things shew how the wind blows, and many may, if they wish, learn lessons from this incident.

The site is the best Madras could have selected. The building will be open to and faces the sea—and there will therefore always be a continual flow of fresh sea air, to wet the wisdom of the Judges, and to sharpen the wit of the lawyers, and to cheer and encourage litigants on both sides! The criminals will be over-awed we hope, both by the majesty of the law and of the sea, and make a ready confession of their crimes, and all business people feel that they have only to shout hard in their offices to be heard by their lawyers at the courts. The Romans were said to take their laws and their courts with them wherever they went, but Madrasses will after this have theirs within and without and all about them, and ought to be a happy, prosperous, contented people. If they do not have the masonry walls of the buildings in this affectionate proximity, they will have, what is more important, the fleshy walls of native lawyers that now throng the city, and constitute its newest, truest and highest guarantee of truth and justice in Indian administration, its Highest Court of acquittal where such things can be in a subject race.

The greatest energy, it is said, is being introduced in preparation of the detailed plans. Formalism, red-tapeism and all other sort of delayisms, is being put to one side to urge this on, and the Consulting Architect, we hear, has been relieved of most of his ordinary duties, that he may give his undivided attention to this one great work, so that we soon hope to see the foundations laid. Materials are being collected.

A good deal of attention has for the last five years been given to what is here known as the South Beach, which, we trust, with its magnificent marina, has now been made beautiful for ever, and that the wand of our local magician will be soon turned to the North Beach, where nature is laying the foundations of a new township, but where many things at present look weedy and neglected. We trust that with the inauguration of the new court will commence a new era for the North Beach, which possesses many possibilities for vast improvement.

#### NOTES ON INSPECTION OF THE DARJEELING-HIMALAYAN RAILWAY.

##### II.

BY COLONEL, A. LE MESSURIER, R.E.,

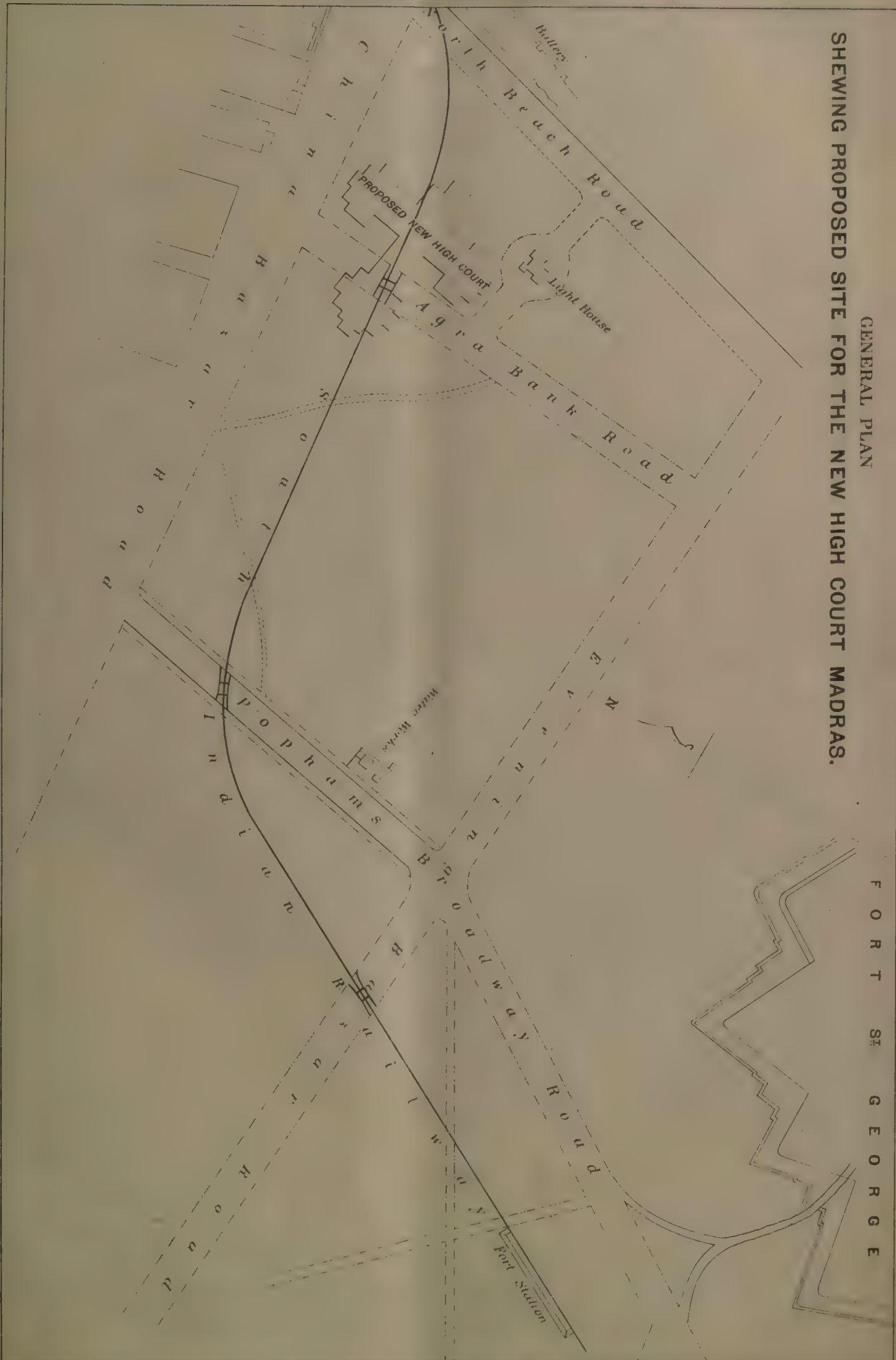
*Officiating Consulting Engineer for Railways, Calcutta.*

IN crossing and re-crossing the head of the valley many difficulties have been encountered, chiefly from the sides of the hills slipping down. In watching the alignment of this "great reverse," and in noticing the contour of the hills from different points between the 24th and 30th miles, the impression conveyed is that the whole of the head of the valley (covering an area of at least a square mile), is one gigantic slip, or a series of slips, directly from the crest of the high range which encircles the route, and that no portion of the line from the 25th to the 26th miles, and from the 27th to 29½ miles, is on what may strictly be called 'sound' ground. The *débris* of the hill sides—a strange mixture of earth and boulders—and the faces of bare rock in places, all tend to confirm the idea that the whole head of the valley is, or at one time has been, on the move. The movement, however, is gradual, and the measures of ordinary precaution which are being completed under the Resident Engineer, are, to all appearances, for the present sufficient.

The chief slips are known generally as those of Pagla Jhora. They are fully described by Chief Engineer, Bengal, in his Report. All retaining works have been built except one which is in progress, but the good supply of stone (required by the Chief Engineer's remarks against mileage 25) has not been kept, as the Resident Engineer says there is material enough and to spare everywhere at a moment's notice. The very great care and judgment which has been noticed by the Chief Engineer as having "been exercised on the extensive protective works on this drainage" is most apparent, and



GENERAL PLAN  
SHEWING PROPOSED SITE FOR THE NEW HIGH COURT MADRAS.









Mr. Barnard, the Resident Engineer, still evinces an active and intelligent interest in the works committed to his charge.

A suggestion is made by Major Sedgwick, in a report dated May 1887, for an incline, self-acting, or otherwise, at or near the 26th mile, with a view to reduce cost of haulage, and as an alternative route in case of landslips. The Chief Engineer, Bengal, is opposed to this scheme, and consider that if at any time the necessity for abandoning the present alignment should arise, the diversion contemplated in 1879 would be the proper alternative.

This diversion has not, I believe, been surveyed, and there is no design of Major Sedgwick's suggestion. The incline would probably mean a lift of 800 feet in half a mile between  $24\frac{1}{2}$  and  $29\frac{1}{2}$  miles, in the place of rising the same height by the present route in 5 miles. The Manager prefers to keep the present road because of the traffic which is drawn from Gumti.

From Gyabari the Railway runs north-west for about 2 miles to Kurseong Station at the 32nd mile. Thence in a northerly direction it follows below the crest of the hills which define the eastern watershed of the Balasun, past Kurseong Hotel siding, Toong Station and siding near the 36th mile, the Chuttuckpur siding, the Brewery siding at the 40th mile, Sonada Station, Rungbul siding below Senchal across the saddle at Jor bungalow and past the 47th mile to Ghoom Station, the highest point on the line, 7,430 feet above the sea. From Ghoom, the direction is to the north-east along the east slope of Jalapahar, the grade falling to Darjeeling at  $50\frac{3}{4}$  miles.

Below Kurseong some 'alterations' have been made in the Railway under the head of improvements. The result is that in flattening the grade the Railway has been lifted to a height of some feet above the road, and in easing the curves more of the public thoroughfare has been utilised than perhaps was at first contemplated by Government. Here is an instance where I think some standard of construction, and specification of works, is shewn to be very necessary. Are the extended slopes of the improved line to be allowed to occupy more than the Railway portion of the road, so that passing carts cannot help over-running and damaging the Railway bank? Are the improved curves, which entail extra cart crossings, to be left unramped and unprotected with guard-rails? (in many crossings, no guard-rails exist at all). They are essential both inside and outside the main rails. On the other hand, the road, from the fact that grass is growing on its surface in many places, may not, perhaps, carry much cart traffic. The question, then, admits of a simple solution. Does Government wish to maintain the cart-road or to abandon it? The occupation of the road by the Railway can best be described by a transposition of words. Government, in 1879, granted use free of cost of such portion of the existing cart-road, &c. The Company, in 1888, have made free use of the road.

At Kurseong the passenger train pulls up on the main line in the middle of the bazar. There is a back siding, and a branch siding into the goods yard.

The slip at 35 miles has extended altogether about 20 feet out, and 20 feet down, during the last 2 years. The old parapet at the shoulder being visible from the road above. The Resident Engineer states that the catch water drain has been cut.

At  $39\frac{1}{4}$  miles the Railway 'improvement' again occurs to the deterioration and partial obliteration of the cart-road. The line is raised, crossing and re-crossing the cart-track. Correct plans and sections of the line ought to be prepared (without doubt at the cost of the Company), and no such alterations and additions ought to be permitted without the sanction of the Local Government, and in important cases, without formal inspection in addition.

At Sonada Station there is the through line, with one siding on the road, and a dead end siding under a shed. The buildings are indifferent, in fact, they are so through-

out the whole line, without any particular guard or precautions against accidents by fire.

Ghoom Station is evidently an important one: the first thing that strikes the traveller is that the train itself is but an item in the crowd: begging children run along calling for *backsheesh*; men and women hustle one another to get out of the way, or to get a peep at the train; and groups of children stand in the *gullies* attempting to touch the carriages as they pass. It is common ground. There is an indifferent station, a goods shed and a long siding. There is a telegraph with single wire, and the station yard is worked with hand signals.

Between Ghoom and Darjeeling the 'improvements' continue, and with this difference, that from the quickly recurring salient and re-entering curves of the line, the cart-road will, during the rains, be turned into a series of ponds, as little or no drainage is provided for in the Railway bank.

Speaking generally, I am of opinion that the drainage of the line itself is defective; that the ballast is bad (it should be of small, clean-broken stone cubes throughout, especially on a hill where the rainfall is as high as 200 inches); that a 'standard formation' is wanting; that ordinary construction at road crossings is ignored; that essential records and plans are not correct and complete; that the buildings could with advantage be of a more substantial character; that more care is required in traffic working at or near all stations and finally, notwithstanding these minor wants, that the road itself is in first-rate running order. Fang-bolts are not in use. The Locomotives weigh 12 tons, not 8.

The terminal arrangements at Darjeeling appear to be sufficient. The great danger here again is from fire.

The composition of the trains would appear to be, viz:—

1 Engine (Sharp and Stewart) weighing	12 tons.
2 Covered goods wagons, each weighing 23 cwt, and carrying ..	110 mds. each.
1 First-class carriage, weighing 12 to 15 cwt. and carrying	12 people.
2 Second " " " " " "	12 " "
3 Third " " " " " "	12 " "
1 Trolley, 1st class, carrying	6 " "
Post Office and brake	6 " "
1 Trolley, 1st class	6 " "

The Up-hill goods trains chiefly consist of 5 wagons, in all weighing probably 1 ton each, and carrying a load of 500 maunds. The Down-hill goods trains may take 750 maunds.

The lowest rate for goods is 1.88 pies per maund per mile, inclusive of handling for potatoes "Down," and 1.41 pies for coal and coke in bags "Up," per maund.

The Capital expenditure on 31st December 1887 amounted to Rs. 27,43,214. The expenditure for the year was Rs. 2,66,528, and the earnings amounted to Rs. 4,77,151. A dividend of 3 per cent. was declared for the first half-year, one of 4 per cent. for the second half, to which another 2 per cent. was added by the shareholders from the undivided profits, making altogether 9 per cent. for the year, and Rs. 8,006 carried forward.

Whether the Government claim on the moiety of the excess profits for 1887 can be set aside, is, I presume, a point still to be settled.

The total passengers carried during the year were 34,500, and the weight of goods 534,778 maunds.

Of coal supplied by the Bengal Company from Barakur, 1,800 tons were consumed at a cost of Rs. 31,566. The consumption being 38.11lb. per mile, at a rate of 4.64 annas per mile.

As regards speed, the Government of India sanctioned an increased speed of 9 miles an hour in the Upper Section of the line, on the distinct understanding that this speed is never on any account to be exceeded, and that trains on this Section are not permitted to make up time with a further restriction if requisite during the monsoon. As a matter of fact this order is disregarded, for trains on the Upper Section certainly run at from 12 to 15 miles an hour.

CALCUTTA; The 20th April 1888.



## THE SEWERAGE OF THE FORT OF MYSORE.

BY STANDISH LEE,

Sanitary Engineer, Mysore State.

## VI.

THE foregoing cost, as will be seen, is only for the public or street portion of the scheme. It has been separated from what follows as opinion is divided as to whether the House-drains (without which the sewers are useless) should be a charge against the Municipality or against individual house-owners. If the matter be left to the decision of owners, the result would undoubtedly be, in most cases, that they would generally see good reason why matters should remain as they are, and the expense involved in making a connection with the public drain avoided. It is, therefore, most desirable that the Municipality should undertake both the street and house-drains, and execute the whole work completely out of public funds. It will be shown further on, that this is quite feasible if the necessary funds be borrowed, and that it would then impose no hardship on any party but would make posterity as well as the present generation, contribute equally towards a scheme that will equally benefit both.

## Abstract estimate of the Probable cost of House-drain connections.

Quantity.	Particulars.	Rate.	Amount.	Total.
		Rs. As. P.	Rs. As. P.	
9,200	R. feet of 3 in. pipes for 400 houses, at the rate of 20 ft. per junction between the street-pipes and houses	0 5 0	2,575 0 0	
9,200	R. feet of Laying and jointing 3 in stone-ware drain pipes in 3 ft. working lengths including cement	0 1 0	575 0 0	
1,533	C. yds. of Excavation of earth for pipe tracks, refilling after laying the pipes, and properly ramming and dressing the surface	0 5 0	479 0 0	
6,000	R. feet of 3 in. pipes for 300 houses at 20 feet each for house drains	0 5 0	1,875 0 0	
400	No. 1 Gully traps	8 0 0	1 380 0 0	
600	No. 1 Bends in streets	0 12 0	845 0 0	
300	Laying and jointing house drains with necessary Masonry work	8 0 0	2,400 0 0	
1600	Masonry house-drain connection at per house	10 0 0	1,600 0 0	
600	2 in. Iron Rain-water pipes in 6 ft. lengths for ventilating shafts for houses	1 2 0	91 0 0	
10	Cowls	15 0 0	150 0 0	
45	Tons Freight by native craft from Bombay to Cannanore including shipping charges, and bunder fees, cart hire from Cannanore to Mysore	22 0 0	990 0 0	
	Superintendence and sundries at 10 per cent.	...	1,240 0 0	
	Total Rs.	....	....	14,000

In the prosecution of inquiries in connection with the preparation of this scheme, the fact that the age at death of persons in the Fort was very low, was impressed on me by the circumstance of the owner of the house being, in 3 cases out of 10, a child of tender years. The parents, who, (judging from the children) probably had not attained 30 years, being dead. Sanitarians assert "that death, as it ordinarily occurs, is a preventable event;" and it is a well established fact, in England, that the average age at death has risen, from 30 years to 45 years, consequent on the introduction of sanitary measures into districts known to be unhealthy.

There are no data available for calculating the death-rate of Mysore, and, perhaps, its bearing on the living is not even generally understood. Let, therefore, Madras be taken as an illustration. Previous to the introduction of Red-Hills water, Sanitary authorities declared cholera to be endemic in that town. The death-rate from all causes of 1871-72 was 29.3 per 1,000. Since 1872 (when the water works were opened) cholera has often been entirely absent for long periods and has at no time been epidemic. The death-rate has steadily fallen to 25 per 1,000, that is, the lives of 5 persons out of every 1,000,

who would, but for Sanitary expenditure by the Municipality, have been numbered with the dead, are, now preserved annually to their children and relatives. But this not only means that *lives* have been *saved*, but also that sickness has been *prevented*; and Medical men know, that for every life saved many cases (some compute them at 28), of serious sickness, with all attendant suffering and expense, are prevented.

Since data are wanting for Mysore, an ideal case, by no means overdrawn, will be stated. The population of this town is 60,000, and supposing the death-rate to be 33 per 1,000 (it is probably much higher), and that rate reduced to 23 by supply of Kookarhully water, and by proper sewerage, the annual saving will be

10 lives per 1,000 in a population of sixty thousand = 600 lives saved; which means 600 funerals less, at, say, Rs. 10 each ... .. = Rs. 6,000  
And the 600 lives saved  $\times$  28 cases of sickness prevented = 16,800 sick cases; which at the small sum of Rs. 5 saved in each case of prevented sickness ... .. = Rs. 84,000

Total saved ... Rs. 90,000

But this is not all that the community pays, for, apart from physical suffering, the actual loss in money, when it comes to be calculated, is much more.

It has been stated that the average duration of life in this town is only 30 years. If this term be extended to 40 years (which is within reasonable bounds, and has even been exceeded in the experience of other towns), then 10 years of a life now prematurely cut off by preventable sickness, would be saved, and valuing such life at only Rs. 2 per month, we have:—

600 lives saved in a year  $\times$  10 (years)  $\times$  12 (months)  
 $\times$  (Rs.) 2 = ... .. Rs. 144,000  
And by funerals saved and cases of sickness prevented. ... .. „ 90,000

Total loss avoided per annum ... Rs. 2,34,000

In the face of these figures, (which are rather under, than over, the actual amounts,) it would be folly to urge, that the people cannot afford proper drainage and water-supply, for what is now irrecoverably lost to the community at large, in a single year, would, more than cover all expenditure for the necessary works throughout the town. It is not the poor alone who pay this terrible penalty of untimely death, though it falls heaviest on them. Outraged nature exacts her penalty from rich and poor alike, for, when surrounded by such conditions as abound within the Fort and all over the town, the King in his Palace and the beggar in the streets, are both equally liable to be called upon to pay the penalty. However occult might be the connection between death by cholera, and defective drainage, it has been proved that, places formerly most favorable to the spread of the disease have become quite free from it, when afterwards properly drained.

Taking the population of the Fort at 4,135, these works involve an annual charge per head of only 9.7 annas, which would be covered by a rate of  $\frac{1}{2}$  per cent. on the value of house property as shewn below:—

Interest on a loan of Rs. 30,000 at  
6 per cent. ... .. = Rs. 1,800  
Sinking fund to pay away the loan in 30 years  
@ 2 per cent. ... .. = „ 600

Total annual cost ... Rs. 2,400

Value of house property within the Fort, on which tax is now collected (excluding the Palace) ... .. Rs. 5,00,000  
A tax of  $\frac{1}{2}$  per cent. on the above value would yield ... .. „ 2,500



The various details—that had to be worked out for determining the size of the pipes, the requisite fall, the depth of the man-holes, &c., are clearly and minutely set forth in the Tabular Statements that follow, so that any error in the calculations may be easily detected.

CONSERVANCY.

Main-sewering, house-draining, and works of water-supply will not alone, without persistent and continuous good scavenging, prevent disease. All middens and cess-pits, where house refuse and ordure are collected for sale as manure, should be closed, and all the scavenging placed under the absolute control of the Municipality. When house-holders are left to scavenge their own premises it is never done properly, if done at all. All street refuse should be cleared away daily and taken to some dépôt conveniently situated. Such of the refuse as will burn should be burned, and the other forms of refuse should be harmlessly disposed of outside the inhabited area.

It is a mistake to accumulate refuse, which is liable to become offensive, with the object of selling it, as it is no portion of Municipal duty to make a profit, but to produce cleanness. The great advantage of disposing of sweepings by burning, lies in the possibility of erecting furnaces or cinerators in each neighbourhood, so that each locality may be able to get rid of its own productions. The cost of cartage to a central dépôt would thus be saved, and the inhabitants of leading thoroughfares would not be annoyed by the foul odours arising from sweepings while in transport through long lines of crowded streets.

Burning refuse, for obviating the dangers attending their storage, is not of recent origination. The Jews, it is known, kept a furnace called "Gehenna" or "Hell fire," constantly burning in the valley of Hinnom, into which the refuse of the City of Jerusalem was daily cast. Ancient Hindu practice is also in favor of purification by fire.

In Plate VIII. are two illustrations of a furnace, known as the "Beehive Destructor" invented by Mr. Stafford of Barnby. The furnace is circular in plan, 7 feet in diameter, and 7 feet in height. Fig 1 is a front elevation, and Fig. 2 is a side view. A is the feed-hole for refuse, running too and fro on rollers, and nearly on the level of the platform where the refuse is shot; B, feed-hole for fuel; C, peep-holes; D, air-holes; F, wrought iron bands, carried round circumference; F, water hearth. It is made entirely of fire-clay bricks, with the exception of the chimney, and is capable of burning 24 tons of rubbish per day. The residuum, which is remarkably small, falls into a water tank underneath (F) where it is quickly cooled, and the steam evaporated from the water tends to keep the bars of the furnace cool.

It must, however, be noted, that an unfavourable opinion was formed of the cinerators introduced into Madras in 1872; but this was entirely owing to want of skill on the part of the work people, and to prejudice on the part of the supervisors.

In conclusion, it cannot be too strongly urged, that works of sewerage or water-supply will not improve the health of the town if the slums are left untouched. These places, so long as they are allowed to remain, will prove nests of contagious disease, out of which will continue to stalk forth the grim forms of typhoid and cholera.

S. L.

THE Railway which it appears is actually to be built between Jerusalem and the Mediterranean will commence at the port of Jaffa, and run in a south-easterly direction by Yazur, Beit-Dejan, Ludel, Yalo, Soba, and Kustul to Jerusalem. Its length will be 33 miles. The construction will be attended by Engineering difficulties in consequence of the barren and hilly nature of the country through which the line will run. Jerusalem is situated some 2,624 feet above the level of the sea, and the territory in its vicinity will tax the ingenuity of the Engineer.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.  
XXXVI.

PARTITIONS—tongued and grooved 1" thick. Teak-wood excluding framing.

Items per one s. ft.	No. or Quantity.	Rate.	Amount.	Total.
(1)	(2)	(3)	(4)	(5)
<i>Labor.</i> —				
Carpenter No. ...	0.1	Variable.	Do.	Do.
Coolie " ...	0.36			
<i>Materials.</i> —				
Teak plank 1" thick, including waste c.ft....	0.091			
Screws 2½" No. ...	2			
Sundries				
Petty Establishment ...	...			
Total per s. ft. ...	...			

NOTES FROM HOME.

(From our own Correspondent.)

THE Great Western and Great Northern Junction Railway Bill has now received the sanction of both Houses of Parliament. Powers are contained in this Bill for the construction of a line starting from the Great Western Railway at Southall passing over the London and North-Western at Harrow with a junction thereat, and terminating with a junction with the Great Northern Railway at Edgware. The proposed line is 10 miles long.

The London Sea Water Supply Bill has been recently passed by the unopposed Bill Committee of the House of Commons. By this Bill, which has now received the sanction of both Houses of Parliament, an extension of time is granted for two years from this date for completing the works authorized in 1881 for bringing a sea water supply to London from the Sussex Coast. The reservoirs will be near Clapham Junction and at Hammersmith.

During the two years that the Contractors have had the Thirlmere Aqueduct of the Manchester Water Scheme in hand, the works have made considerable progress. The more difficult portion of the work comprises the borings of tunnels about 7 feet in diameter through the solid rock under Dunmair Rise, Nab Scar and Moor House, and these are almost complete.

Although to some extent the bad weather has interfered with the operations of the Contractor, the progress made in the works of the Manchester Ship Canal is reported to be exceedingly satisfactory, and the work is quite up to, if not beyond, the amount estimated to be finished by this time, in order to have the works completed within the stipulated period. The Contractor is making arrangements for a large quantity of new plant, and on several sections of the canal work is being carried on by night as well as by day.

Good progress is being made with the works in connection with the Tower Bridge over the Thames. The north pier is practically completed to the level of high-water mark, while the south pier is in progress, and about half its foundations are finished, and the northern approach extending from the north abutment towards the Minories is also far advanced. The excavations for the southern abutment are being proceeded with behind a coffer dam.

The Builder gives photographs shewing the progress of the works of the Forth Bridge, one of them a large scale picture of the Inch Garvie cantilever. Although considerable progress is being steadily made, the view shewing the piers in their present state gives an excellent idea of the immense gap that there is still to be bridged by the cantilevers and the straight bridge in the centre. These photographs form interesting records, and explain very much more readily than descriptive matter, a mass of which would be required to convey the same information.

Apropos of this undertaking appears a notice of Mr. Middleton's book on the triangulation and measurements of the Forth Bridge. This book will be found a useful addition to the Engineer's library, as it gives the author's practical experiences in carrying out the preliminary survey of the greatest Engineering work of modern times.



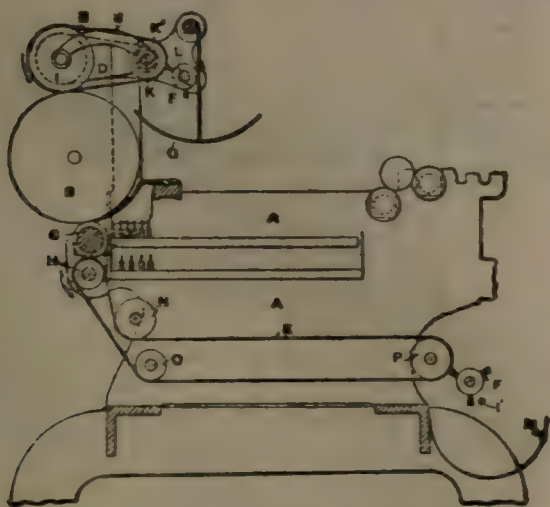
55 of '88.—William Nutter, of F. Nuterott Road, Naylor Road, Putnam, London, S. E., England, Commercial Traveller.—For a Safety Lamp burner.



- 65 of '88.—Charles Tellier, of Paris, in the Republic of France, Civil Engineer.—For an improved apparatus for heating, aerating, and filtering natural and artificial waters and other beverages.
- 94 of '88.—Augustus Gross, Nautical Instrument Maker, of Newcastle, in the Colony of New South Wales. For electrical appliances for a Mariner's compass to give alarm upon deviation from the ship's course.
- 97 of '88.—William Alfred Gibbs, of Gilwell Park, Sewardstone, in the County of Essex, England, Esquire. For improvements in and connected with furnaces and apparatus for the production of hot air for drying and other purposes.
- 104 of '88.—Fritz Grossmann, M.D. of Berlin, in the Kingdom of Prussia and German Empire.—For an improved Hygienic Bandage for women.
- 107 of '88.—Charles Taverdon and Auguste Ludovic Taverdon, Engineers, of Paris, in the Republic of France.—For process for the manufacture of castings, or parts of mechanism.
- 108 of '88.—Charles Taverdon and Auguste Ludovic Taverdon, Engineers, of Paris, in the Republic of France.—For improvement in rotary engines.
- 109 of '88.—John Joseph Hooker, of Tideswell, Stockport, in the County of Derby, England, Clerk in Holy Orders, Herman Leacher, of 6, Clement's Lane, Lombard Street, in the City of London, England, Accountant, and Robert George Schwarz, of 110, Cannon Street, in the City of London, England, Commission Merchant.—For improvements in apparatus for stopping and starting vehicles.
- 114 of '88.—Alfred Buckingham Ibbotson, of Ibbotson Brothers and Company, Limited, Globe Steel Works, Sheffield, England. For improvements relating to lock-nuts for screw-bolts.
- 115 of '88.—Walter Whitfield Bostwick, of London, England, Engineer.—For improvements in folding or collapsible gates, shutters, or window guards, and the like.
- 117 of '88.—John Stinson Farmer, of Canterbury Road, Kilburn, in the County of Middlesex, England, Engineer.—For improvements in interlocking apparatus for railway points and signal levers.

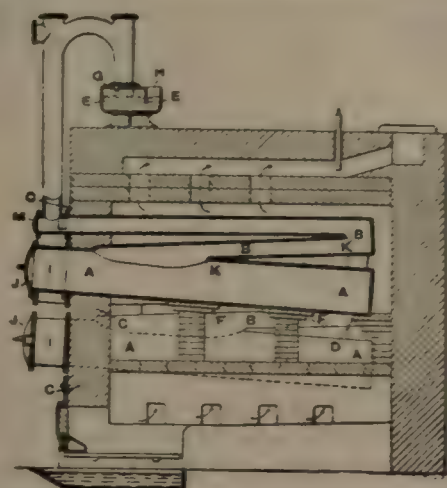
#### RECENT BRITISH PATENTS.

**SPINNING MACHINERY.**—*J. Wallace, Belfast.*—This invention introduces an improvement in the rubbers or cleaners used for keeping the rollers in a clean condition, and for preventing the adherence of fibres to them. The ordinary rubbers hitherto in use are made of flannel, fastened to revolving bosses which press against the rollers; this arrangement is liable to allow some of the dirt to pass from them to the material which is being operated on. The present inventor employs cleaners which are made of travelling bands of flannel or other material, and means are also provided for automatically cleaning these rubbers. The accompanying figure illustrates the application of this method. A is part of the frame of the machine, B is one of the pressing rollers, and C one of the boss rollers. A roller I of metal is carried by the arms J pivoted upon a driving shaft K, so that the rubber roller



I will rest upon the pressing roller B with a freedom of movement towards and away from its axis. A boss K<sup>1</sup> is fixed on the driving shaft K, and round the roller I and the boss K<sup>1</sup> is passed a leather driving belt D and a band of flannel E. Near to the driving shaft K is placed a brush F, which cleans the belt E, and keeps it rough, and the axle of the brush is mounted in slots L; the trough G catches the droppings from the brush. In applying this method of cleaning to the boss roller C, the inventor passes another belt of flannel E round a revolving roller H, under the guide pulleys N O, and round a roller P; and a similar brush F and trough M are employed. This belt also carries the droppings from the rollers, and delivers them into the same receptacle. A rod may be fixed in close proximity with the revolving brush F, in order to free it from any dust which becomes attached to it. Four claims are made for this rubber, which consists of a travelling belt of flannel arranged as described.—No. 5985. April 25th, 1887.

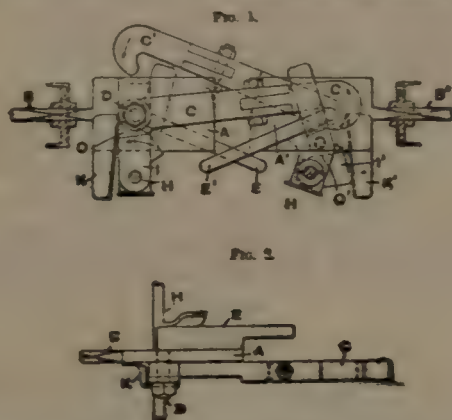
**MANUFACTURE OF GAS.**—*J. H. R. Dinmore, Liverpool.*—The objects of this invention are to cause the heavier hydrocarbons to become more permanently suspended, and to arrest a great portion of the tar before it reaches the hydraulic main. For these purposes the retorts and



apparatus are arranged as shown in the accompanying figure. A is the main cast iron retort, and B is a duct through which the distilled gases pass, after their evolution in the retort. The retort door is shown at J; the seating consists of the front wall C and the pedestal D. In practice three retorts may be used, and their settings are such that they shall be protected from the destructive effect of the flames, and maintained at equal temperatures. This is done by shielding those parts nearest the fire by brick work and by the slabs F. In order to allow of all the parts being cleaned, the retort and duct are so constructed that they may all be scraped from their mouths, and the parts K are formed as a feather edge. The ascension pipes lead to a hydraulic main E, whose dip pipes G are inserted into the liquor for a small depth only. The gas is thus allowed to pass freely out and into the main, and little back pressure is caused in the retort. The main is open at E<sup>2</sup> to the atmosphere, and any undue pressure is thus prevented within it. It is claimed for this arrangement of the retort and duct, and flues surrounding them, that a greater lighting power of the gas is obtained by the heavy hydrocarbons being more thoroughly utilised by their subsequent heating in the duct. Two claims are made for the retort and duct, and for the arrangement of the hydraulic main as described.—No. 1767. February 4th, 1887.

#### RECENT GERMAN PATENTS.

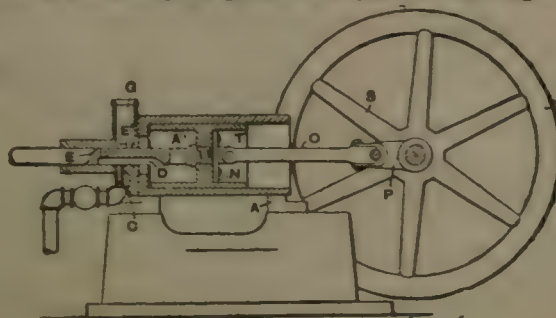
**RAILWAY COUPLING.**—*A. Bolzano, Augsburg.*—This invention shows a new form of automatic coupling for railway carriages. The draw bar B carries at its end a plate A, to which a hook C is connected, pivoting round the horizontal pin D. The other side of A is provided with an inclined plane E. In shunting the carriages together, the



hooks slide along the inclined planes, and engage with the upper ends of the latter. The hooks C are provided with projections O to which the shafts H are connected. These shafts are fitted with cams I. In order to disengage the hooks, or to prevent their engaging, the cams I are put into the position shown on the right hand side of fig. 1, when they engage with projections K, and lift or keep the hook in the position indicated.—No. 42978. August 27th, 1888.

#### RECENT AMERICAN PATENTS.

**GAS ENGINE.**—*G. W. Stewart, New York.*—This invention relates to a method of introducing the gas into the cylinder of the engine, and





the accompanying figure illustrates the mechanism employed for that purpose. The piston has an extension A', which passes through the hinder end of the cylinder. In this circular rod is a groove D, which allows the gas to find access to the cylinder from the gas supply pipe C. There is also a narrow port E in the rod A', and a port E' in the surfaces on which the rod bears. When these two ports register with each other the flame in G is communicated to the charge in the cylinder, and the explosion takes place. The air supply and the exhaust mechanism are not shown in the drawing. Four claims are made for the extension A', and for the grooves in it, as described.—No. 381488. April, 17th 1888

ADVERTISEMENTS.

NOTICE.

TENDERS are invited and will be received by the Undersigned up to the 31st August 1888 for the purchase of the Hull of the Government Iron Vessel "Cassandra" of 299 <sup>3</sup>/<sub>100</sub> tons, Length 110 feet, Breadth 25 feet and Depth 13' 9".

The vessel is laying off the Salt Golah Moorings, Howrah.

For further particulars applications should be made to the Undersigned, who does not bind himself to accept the highest or any tender.

EATON W. PETLEY,  
Offg. Port Officer of Calcutta

Calcutta Port Office ; }  
The 21st July 1888. } (167)

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H. G. KUNHARDT, CAPT., R.E.,  
Manager, T. S. R.

Mozufferpore ; }  
The 10th August 1888. } (177)

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F. SILLS, C.E.,  
EXECUTIVE ENGINEER,  
Chittagong Division.

CHITTAGONG ; }  
The 3rd August 1888



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**J. D. JONES,**  
*Mechanical Engineer,*  
**PROPRIETOR.**

(108)



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Telegraphic Address—"SILVERGRAY," CALCUTTA.

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Re-insurances ... £769,265 0 0	Re-insurances .. £125,559 0 0	Re-insurances ... £175,118 0 0
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Losses after deducting Re-insurances ... £443,587 0 0	Claims less Re-insurances, £ 79,229 0 0	Losses after deducting Re-insurances .. £138,365 0 0
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(179)



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## NOW READY.

# "Artesian Borings in the Sunderbunds."

As the issues of the journal containing the articles headed as above are out of print, and sufficient inducement having offered, the matter has been reproduced in pamphlet form to meet the requirements of District Officers and others in Bengal and elsewhere.

Price Rs. 2 per copy.—Cash.

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# Obituary.

HARVEY.—August 10th, at Khojak Pass, Lieutenant H. G. Harvey, B.E., aged 25 years.

CARTER.—On August 18th, at Cumballa Hill, Bombay, Major Charles Carre Carter, Royal Engineers, aged 37 years.

# INDIAN ENGINEERING.

SATURDAY, SEPTEMBER 1, 1888.

## LEGISLATION FOR INDIAN COAL-MINES.

THE saying that there is no one so blind as he who will not see very appropriately applies to the case of a contemporary who has started the subject of Mining Regulations for India, after it has been authoritatively settled by the head of the Executive that no necessity for it exists. Advantage has been taken of the recent disaster at Kimberley in South Africa to make capital out of it, and the Government is called upon to place Indian mines under supervision. We shall presently shew that the agitation is a spurious one, and will serve no purpose in persuading the authorities to stultify themselves.

On perusing the articles of our contemporary and the correspondence that has been published in its columns, a lurking suspicion arises that they have been inspired by "the greatest mining authority" in this country, but since no such particular individual in flesh and blood is known to the public, we may be excused for not entering into a controversy with a shadow.

Crude hasty legislation is the bane of India; a great many of her misfortunes may be directly attributed to it. Whether we turn to its civil, criminal, revenue or industrial administration, we see everywhere indications of the mischief which the legislative machinery has created. A law is passed to-day after years of deliberation, to be modified after a few months, or at best a few years, as if the conditions which called for modification did not exist when the enactment was passed. It would be tiring our readers to cite instances in support of our contention, but to take a recent case, let us consider the Debtors' Act. It was coached through the Legislative Council with a flourish of trumpets, and the Members of the Mutual Adulation Society congratulated each other on the happy issue. Great was the joy throughout the land that the gates of jails would not prevail against impecunious but honest debtors. But what has been the result? It was reserved for the Registrar of the Calcutta Small Cause Court to discover that the Act did not apply to that Court. A modification became an imperative necessity, and the Council has been brought into requisition to remedy the defect. Such is the part that legal machinery plays in promoting the happiness of the people. It is to the body politic what Morrison's pills are for suffering humanity,—a specific for all ills that flesh is heir to!

Now the first question in connection with the demand for Government interference in the management of mines is what are the arguments adduced in favor of it. It is said that as the industry has of late greatly developed, the Executive should exercise a supervising power—in other words, after years of successful management without the aid of Government it should now be hampered with restrictions for crippling it. There is no doubt that



if once the thin end of the wedge is inserted in the way of legislation, its pernicious influence will do a great deal of harm, and ultimately ruin the industry. It is an admitted fact that where there is no ailment there must be no application of a remedy in anticipation of an evil. The contention that there are laws in England regarding the regulation of mines will not hold good in this country for a simple reason that the two cases are not analogous; and therefore the protective measures employed at Home have no bearing in India, where other conditions are prevalent, and where the industry is yet in its embryo stage. Protective measures to adjust the relations between master and servant are harmful to a degree, unless its necessity is proved, which is conspicuous by its absence in this country. We have always entertained the opinion that when people are allowed to settle their own terms business is carried on more smoothly than through the officious intervention of a party who has no concern or interest in it.

It should also be considered how long a period it took for England to legislate on the subject. It was in 1843 that the first Inspector of Mines was appointed, that is, after the Mining Industry had been in existence and in active operation for 550 years. If it took upwards of five centuries for England to move in the matter, why should there be undue haste in introducing the measure in India? In the same year the total output of the mines of the United Kingdom was 43,000,000 tons; the Indian output is barely 2,000,000 tons. In England, irrespective of the extent of the underground works, most mines are provided with only one pit, while in India there is something like a pit to every acre of working, and the deepest shaft is not more than 400 feet below the surface of the earth. But the most material point is the existence of 'firedamps' and other dangers in the British mines; but as regard India opinions of experts have decided the point beyond further question. Dr. Saise says:—"The lamps used by natives are bits of earthen-ware, on which a little oil is poured, and wick laid, the end of which is lighted. There is no firedamp. Ventilation is natural and easy from the number of shafts. It is only in the deeper ones that arrangements are made for producing and directing air currents." Then, again, Ball says:—"A perfect freedom from fire and choke damp render it possible to carry on the work without its being necessary to adopt the precautions which in England only too often fail to secure the object aimed at."

There are mines interspersed all over the country—in Bengal, Assam, Punjab, Central Provinces and Southern India, and would one codification suit all conditions and systems? Would it not rather handicap one province and leave another untouched, and will any amount of legislation rectify this, or is it proposed to have a separate law for each province? Take the case of the Bombay Factory Act; a benign and paternal Government undertook the protection of its subjects employed in the mills of that Presidency, and enacted laws for their convenience. Has it worked satisfactorily? No. Experience has

shewn that it does not serve its purpose, and before long there will be a modification necessary.—*Verbum sap.*

#### CANAL IRRIGATION.

A LATE *Gazette of India* contained some correspondence with the Secretary of State bearing on the question of canal irrigation. As Mr. Thornton (formerly one of the Judges of the Punjab Chief Court) remarked, in an address lately made by him to the Society of Arts in London, the canal systems of India have been justly described as the finest in the world. Whether in the form of inundation canals, that is, canals fed by the annual rise of the waters of the Indus and its tributaries, or of perennial canals drawn from the upper waters of the Ganges, the Jumna, the Rabi, and the Sutlej, or formed in the deltas of the great rivers in the south, they have conferred priceless benefits on the community. They have secured from drought upwards of eight millions of acres—an extent of country far greater than the whole of Lombardy, or the entire irrigated area of Egypt; have increased enormously the production of superior crops, enriched the people, and set free the capital required for working wells for the improvement of produce and the cultivation of fresh lands. Within my own recollection, they have turned deserts into gardens, softened the climate of extensive tracts, substituting rich cultivation and foliage for treeless plains swept over by sandstorms; while in Southern India, thanks to the persistent efforts of Sir Arthur Cotton and others, they are largely used as highways for internal traffic.

And yet Indian consumers of canal water are not happy; not even contented, canals bring in their train malarious fever and death, they say. True enough they do. But that is because the ryot insists on his land being swamped instead of irrigated, and because new fangled lines of Railway, constructed long years after the canals were planned, have, with their embankments, water-logged the surrounding country; and so forth. Such defalcations are justly attributable to the great god Stupidity—not to canals.

Popular imagination holds canal water to be a prime source of land impoverishment. But, as a matter of fact, this mischief is peculiar to canals fed from Himalayan sources, and does not follow irrigation from inundation or deltaic water conductors, supplies from which are warm, and charged with fertilizing silt. Sir Arthur Cotton, who is an enthusiast on the subject of canals, denies that any mischief is ever done. But his experience has been altogether in Southern India, and must be discounted accordingly. Water from wells, he says, "is filtered, and almost entirely without fertilizing properties, while river water is so rich as fully to renew the land. Probably canal water is worth three times that from wells." On the other hand, Sir J. B. Lyall held that "constant cultivation and application of canal water tend to take the strength out of the land," and Raja Sir Sabib Dyaz, a Punjab landholder, says, "It is commonly believed in the Amritsar pergunnah that canal water has made the soil poor."—A Mahomedan witness, a Government official,



Mahomed Hayat Khan, says "Irrigation from canals leaves a sandy deposit on the surface of the soil, and weakens it." Mr. Sherer, General Crofton, Mr. Caird—all the people whose evidence is worth noticing who have enquired into the subject—bear testimony to the same effect. But then these mischiefs all spring from over-irrigation—too large a supply of water. Let that fact be noted and acted upon, and we shall hear no more complaints about canal water. So say its advocates. Men on the other side put quite a different color on the argument; quite an opposite color. It would be worse than idle in these columns to recapitulate all, or half, the arguments brought forward *pro* and *con*. For our part, we incline to believe that over-irrigation, a lavish supply of water to canal irrigated lands, is to blame for evil consequences attributable to canals and the use of canal water—fevers and other diseases, to wit—to that and nothing else. The fact of the matter seems to be that ryots, self-seeking, greedy and short-sighted, endeavour to make more out of a good thing than it is capable of. The remedy is efficient drainage, and what a distinguished R. E., calls "copious washing of the soil."

#### THE BUILDING OF A RAILWAY.

WHAT strikes one most on cutting the pages of an American magazine such as *Scribner's*, is the obvious truth, verisimilitude, force, of the illustrations. They are developed in a finished masterly style that English engravers, seem unable to rival, and there are photographs and other adornments besides. A series of pictures illustrates the first article in *Scribner's* June issue entitled "The Building of a Railway." In that connection here is a wrinkle it may be to the advantage of Indian Engineers to consider.

"The key to the evolution of the American Railway is the contempt for authority displayed by our Engineers, and the untrammelled way in which they invented and applied whatever they thought would answer the best purpose, regardless of precedent. When we began to build our Railways, in 1831, we followed English patterns for a short time. Our Engineers soon saw that unless vital changes were made our money would not hold out and our Railway system would be very short. Necessity truly became the mother of invention."

A legitimate subject of Yankee boast in the way of invention is the swivelling truck, which, when placed under the front end of an engine, enables it to run round curves of almost any radius. The next improvement was the invention of equalizing beams or levers, through the agency of which the weight of the engine is always borne by three out of four or, possibly more, driving wheels. They act like a three-legged stool which can always be "set level," we are told. But what hinders the setting of a four-legged stool leveller? We fail to see the force of the argument. "Flexibility" is claimed as a useful feature in American engines, as increasing their adhesion and enabling them to draw big loads. This indefinite quality of "flexibility" is held to equalize pressure on the track, to prevent shocks and blows, to keep the

engines out of the workshop and to render them capable of running many more miles in a year than an English locomotive can. Clearly, praise is due to this American-contrived flexibility, as an aid to Engineering possibilities.

Here is an improved notion about Railway carriages, and the comfort of Railway passengers.

"Instead of the four-wheeled English car, which on a rough track dances along on three wheels, we owe to Ross Winans, of Baltimore, the application of a pair of four-wheeled swivelling trucks, one under each end of the car, thus enabling it to accommodate itself to the inequalities of a rough track and to follow its locomotive around the sharpest curves. There are, on our main lines, curves of less than 300 feet radius, while, on the Manhattan Elevated, the largest passenger traffic in the world is conducted around curves of less than 100 feet radius. There are few curves of less than 1,000 feet radius on European Railways."

It is asserted in this *Scribner* article that the climbing capabilities of a locomotive, upon smooth rails, were not known until, in 1852, Mr. Latrobe, then Chief Engineer of the Baltimore and Ohio Railroad, tried a temporary zigzag gradient of 10 per cent.—i.e., ten feet rise in 100 feet of length—say 528 feet per mile—over a hill some two miles long, through which the Kingwood tunnel was being excavated. This daring feat has never been equalled, says the writer in *Scribner*.

Another American invention is the switch-back. By this plan the length of line required to ease the gradient is obtained by running backward and forward in a zigzag course, instead of going straight up the mountain. As a full stop has to be made at the end of every piece of line, there is no danger of the train running away from its brakes. This device was first used among the hills of Pennsylvania over forty years ago to lower coal cars down into the Nesquehoning Valley. It was afterwards used on the Callao, Lima, and Oroya Railroad in Peru, by American Engineers, with extraordinary daring and skill. It is now employed to carry the temporary tracks of the Cascade Division of the Northern Pacific Railroad over the "Stampede" Pass, with grades of 297 feet per mile, while a tunnel 9,850 feet long is being driven through the mountains.

The Denver and Rio Grande Railway has been compared to an Octopus, because "it sucks nutriment from every place where nutriment is to be found." Aptitude for mountain climbing has helped towards much of this suctional power. When the line was under construction, in one place, the difficulty of blasting a roadbed into the side of the mountain were so great that it was deemed better to carry the track upon a bridge. "And this bridge was hung from two rafters braced against the sides of the gorge." There are resources in art as well as in nature if one only knows where to find them.

THE scheme for a Railway between Constantinople and Bagdad is again being talked about. Its length will be about 1,400 miles, and the country through which it will run is well populated, is rich in minerals, and produces great quantities of grain. The line will also shorten the distance between Europe and India by nine or ten days.



## Notes and Comments.

**WORK FOR THE UNEMPLOYED.**—It is proposed we hear to employ Engineers from the British service to survey the projected Railway lines to Chanda and Raipur.

**ASSAM RAILWAYS.**—We learn that the Consulting Engineer for Railways at Calcutta, accompanied by a Deputy, will shortly proceed to Assam to inspect and report on the out-of-the-way lines in that Province.

**CALCUTTA WATER-SUPPLY.**—The new pumps, settling reservoirs, and filters have already been put into use at Pultah, and the turbid water noticeable in the Calcutta supply during a few days lately was due to this cause.

**REDUCTIONS IN THE P. W. D.**—The Government of India is desirous of reducing the local P. W. D. establishments by 10 per cent., and has already asked the Government of Bengal for the names of those who should be called upon to go.

**A MODEST OFFER.**—Messrs. Grant, of London, have proffered to the Travancore Government proposals to raise capital to open a Railway from Tinnevely to Quilon, provided the latter guarantees interest on the Travancore line for an indefinite period.

**A HARBOUR FOR IRON-CLADS AT BOMBAY.**—Lord George Hamilton on Thursday, replying to Mr. A. E. Field, in the House, said that he believed that a dock for first-class iron-clads at Bombay ought to be constructed, and that the plans had been ordered.

**KHATMANDU WATER-WORKS.**—It is likely that Mr. Fennimore, Executive Engineer, P. W. D., Bengal, will not go to the Nepaul capital for the purpose of preparing a water-supply scheme as before announced, since the inducement offered is not worth the risk and trouble that the work would involve.

**MADRAS COLLEGE OF ENGINEERING.**—Government have approved of the permanent addition to the Board of Examiners for the Madras College of Engineering of an Assistant Examiner for Science, but have declined to sanction the proposed enhancement of the remuneration paid to the President and members of the Board.

**AN EXPLANATION WANTED.**—The *Indian Mirror* grumbles because the 2nd class fare to Hooghly is Re. 1-8 by the E. I. Railway. Whereas a passenger can travel 2nd class to Naihaty on the E. B. Railway—about the same distance—for Re. 1. Our contemporary wants to know why there is this uneven thushness. We should like to know too.

**S. M. R. WORKSHOPS, HUBLI.**—These workshops are very nearly completed, great pains and trouble having been taken in their construction. They are equipped with the latest modern machinery and are probably among the best laid out Railway Workshops in India. Hubli, before the advent of the Railway, was an insignificant native town.

**RAILWAY CONSTRUCTION IN SUMATRA.**—The Netherlands Indian Government has begun the construction of a Railway from the coast in West Sumatra to the Ombilien coal-field in the interior. Though the forests in Netherlands India abound with valuable timber, America has been drawn upon for supplies of wood for the purposes of the Railway.

**SITARAMPUR COLLIERIES.**—A Correspondent writes:—Very bad weather last week—very much rain at all the collieries, and a number of pits at different places are completely flooded. Up to this—since the 1st of January—we have had over forty inches of rain, which

is up to the average fall of previous years. Coal trade is very brisk. All coal stocks are now cleared off.

**THE NEW R. C. CHURCH, SIMLA.**—We understand that the Simla new R. C. Church Building Fund is almost exhausted, and if means are not soon forthcoming, the work will be delayed. It is urgently requested that all who feel an interest in this erection, come forward now and aid in bringing to completion an edifice worthy of the community, and an ornament to the station.

**THE MADRAS HARBOUR.**—At last the Secretary of State has sanctioned the opening of a north-east entrance to the Madras harbour, and estimates to carry out the work have been called for. A sum of twelve lakhs has been sanctioned by the Government of India as an advance to the Harbour Trust Board for expenditure on the Madras Harbour Works during the year 1888-89.

**VICTORIA JUBILEE HOSPITAL, AMRITSAR.**—Mr. Pogson having offered to supervise the construction of the Victoria Jubilee Hospital, either in person on the spot, or from Madras on certain terms which he specified, the Municipal Committee resolved, that Mr. Pogson's offer cannot be accepted. The Committee will make its own arrangements for supervision when the project has been sanctioned.

**THE CEYLON CAPITAL AND SANITATION.**—The Municipal Council of Colombo has been exercised about the drains of the city and its sanitary improvement. It was proposed to go in for a loan of a lakh at six per cent. payable in thirty years with a sinking fund. A discussion ensued on the subject unmarked by any over-fervour. And it was ultimately resolved to form a sub-committee to report on the matter.

**OPENING OUT ORISSA.**—The Orissa Association on behalf of the Trading, Industrial, Working and Priestly classes of Orissa lately memorialised Sir Steuart Bayley in favor of the early construction of the Benares-Cuttack-Pooree Railway. The matter was referred by the Local Government to the Government of India, which has replied that it fully recognises the importance of railway communication in Orissa, and will be glad to entertain favorably any scheme for its development which may be put forward by private enterprise.

**SINGARENI COAL-FIELD.**—A fact now brought to notice, and one that will injuriously affect the future of the field, is that the Railway which could just as easily have been carried *through the Coal-Fields* misses doing so almost entirely, and the consequence will be, that as more pits are opened up, they will get further and further from the line of rail, and the Company that is working the coal will have to make a series of tramways for itself, which would to a great extent have been obviated had the Railway been judiciously laid out.

**ROYAL ENGINEER CORPS NEWS.**—Ordered abroad:—To South Africa: Major W. G. Du Boulay. To Gibraltar: Captain H. W. Renny-Tailyour. To Halifax, N. S.: Captain S. McM. Maycock and Lieutenant W. P. Brett. To Malta: Lieutenant J. H. L. E. Johnstone. To Mauritius: Lieutenant W. S. Speranza. To Egypt: Lieutenant and Quartermaster F. Hooper. Ordered Home:—From Halifax, N. S.: Lieutenant P. R. Burn-Murdoch. From Egypt: Lieutenant and Quartermaster T. C. Symons. Arrived Home:—From Hong-Kong: Lieutenant J. E. Edmonds.

**EQUITABLE COAL COMPANY.**—This concern has declared a dividend of 8 per cent. for the last half-year. The quantity of steam coal and rubble raised during the half-



year was 15,55,467 maunds, being an increase of 5,49,176 maunds over the same period of 1887, and the deliveries were 13,84,298 maunds, against 9,67,288 maunds for the same period of 1887. The new colliery branch of the Bengal-Nagpur Railway is being pushed on and should be open for traffic early next year. The report is a satisfactory one, and fully accounts for the recent advance in the shares.

**P. W. D. RE-ORGANIZATION.**—In our last issue we gave publicity to the fact that the Madras Government were not in favor of adopting the suggestion of the Finance Committee that all local public works should be carried out by the Imperial Public Works Department. We believe that the Government of Bengal favors the Madras view of the question. We hear that the proposals as regards "Imperial" and "Provincial" Engineers have been, on the whole, replied to in the negative—the general opinion being unfavorable to such a marked division of the profession in the country.

**ACTION FOR LIBEL.**—Mr. Frederick Sharp, Executive Engineer, late of Coorg, has filed a suit for libel in the District Court of Mercara against Mr. G. R. Evans, of the Coorg Planters' Association, and claims Rs. 3,500 as damages. The plaintiff alleges that the defendant, as Secretary of the Association, published a report that the roads were in a disgraceful state, that the public works in Coorg were a failure, and the Government had removed the plaintiff in consequence. Mr. Sharp alleges that the statements are false and malicious, and were made to injure his reputation. The case promises to be an interesting one.

**A NICE APPOINTMENT.**—A Mr. F. J. Waring has been appointed Chief Resident Engineer of the Haputale Railway Extension, Ceylon, on Rs. 22,100 per annum, including travelling allowance. He is also to be provided with a bungalow and such number of horses, with saddlery, &c., as he may require at Government expense. This fortunate gentleman commenced his career in 1875 in the Ceylon Railway Extension service as senior Assistant Engineer on a salary of Rs. 6,408 per annum. The rise in salary of nearly 345 per cent., after less than twelve years' service, is a remarkable one even in Colonial history.

**THE MOGUL SERAI-POOREE RAILWAY.**—We are glad to hear that the Secretary of State for India has sanctioned construction of the Railway from Mogul Serai to Pooree, the advantages of which were set forth in these columns some months ago. *On dit* that Sir Bradford Leslie—projector of the scheme and prime mover towards its acceptance by Lord Cross—will come out to India again as Agent and Chief Manager of the new line. We hope that the rumour has a bottom of truth. A better man for the business to be undertaken it would be difficult to find; and nobody is likely to grudge Sir Bradford another Engineering success.

**THE MHOW WATER-WORKS.**—The Mhow Water-Works scheme is fast approaching completion; the pipes have been laid through all the main roads and most of the by-lanes in the cantonment, so that by the end of the year the work should be an accomplished fact. The works might have been completed long ago, had the contract for laying the pipes been given to the Parsee contractor who had the erection of the reservoir and the principal works to carry out. A paltry Rs. 500 however was the cause of the contract being given to a native who, having no knowledge of such work, has made a complete muddle of the job. So much for the P. W. D., or I should more properly say M. W. Engineers.

**THE COMING PARIS EXHIBITION.**—A Correspondent writes:—"Tis no wonder that cautious Continental manufacturers and tradesmen are shy about sending exhibits to the projected world's show, when childishly inclined people are its mainstays and custodians. Moreover, are not world's shows a trifle "played out," as a Yankee would put it? They have done good work in their day. But one may have too much even of a good thing; and it seems to us that the time has come for a little rest and be-thankfulness. From what we hear we do not think India is likely to send much to the Lutetian Exhibition. And M. Joubert, when he did the Calcutta one on contract, gave us enough of that sort of thing to last a long while.

**IRRIGATION IN UPPER BURMA.**—Before this territory was annexed an organised system existed for supervising irrigation works so as to avert disaster, and which cost the late Burmese Government nothing, as the Revenue officers were held responsible for the protection of the agriculturist and that no disaster took place. Consequently bunds were repaired with forced labor and channels opened or closed as occasions required. To maintain these primitive works that are scattered all over Upper Burma would entail very heavy annual expenditure incommensurate with the revenue received, and the Government finds it rather a difficult problem to solve now that high floods are reported at several stations in Upper Burma.

**A PLEA FOR IRRIGATION.**—The Punjab cotton crop this year is forecasted as a short one, the falling away from normal standards being greatest where lands are dependent on rain for their yield. Crops on irrigated lands have not suffered to anything like such an extent as those left uninsured, left to chance, for supplies of moisture. It stands to reason that such results will always follow a season of late rains, or light rains. And yet there are people in authority, men of light and leading, who lose no opportunity of denying and decrying the virtues and efficacies of irrigation! Truth is great doubtless; and does usually prevail in the long run; but it takes a disappointingly long while to prevail—sometimes an inconveniently long while.

**THE TELEGRAPH CABLE BREAK-DOWN.**—The telegraph steamer, *Patrick Sewart*, has been despatched by Mr. Finch, Director of the Persian Gulf Section of Indian Telegraphs, to endeavour to repair the submarine cable which is broken ten miles from Manora. She will afterwards proceed up the Persian Gulf to repair one of the two cables between Jask and Bushire, which has been interrupted since the 13th instant. The land line wires, however, are working well, so that the break in the cable near Manora does not affect the speed in the transit of messages; but by the failure of one of the two cables between Jask and Bushire the speed is lessened by about one-half. The cable now broken has been laid for about nineteen years, and its own sheathing is much corroded.

**UTILIZATION OF LIQUID MANURE.**—With reference to this subject, and to the opinion expressed by Dr. Stephen that liquid manure should not be applied to land within 500 yards of the city wall, the Secretary of the Amritsar Municipality proposed that 500 or 600 acres of open arable land, situated on the side of the main sewage channel, about a mile and a half from the city, should be acquired by the Committee by purchase, and that all the liquid sewage leaving the city should be utilized on this land; in other words, that the Committee should start a sewage farm on the principle now so



generally adopted in England. This proposal was warmly approved by the Committee, and the Secretary was ordered to draw up a full report of the scheme proposed.

**BOMBAY WATER-SUPPLY.**—*The Times of India* says that the general opinion regarding the action of the Town Council in referring the whole question of the leakage of the Malabar Hill and Bhandarwada reservoirs for report by a committee of experts will, no doubt, be that the Council have taken the right course. There are many Engineering details to be enquired into of a more or less technical character which it would have been difficult for the whole body of the Council to discuss with any satisfactory result, whereas by the course which has been adopted, those details can be gone into, in the first instance, by the committee, whose special knowledge of Engineering should enable them to arrive at a correct conclusion, not only as to who is really to blame in the matter of the leaky condition of the reservoirs, but as to what is the best course to pursue in order to make them water-tight. We hope to give drawings of both these reservoirs in an early number to illustrate the points at issue.

**RAILWAY PROVINCIALISING POLICY.**—On this subject our Simla Gossip sounded the warning note in our issue of the 30th June last. We now find the opinion recorded that anything like the general provincialising of the large Indian Railways, which is said to be threatened, is most unlikely to come off, among other reasons, because some of the Provincial Governments are unwilling to accept the responsibility. Thus the charge of the North-West system, which was offered to the Punjab, has already been declined with thanks. The Oudh and Rohilkhand system, which might have been offered to the North-West Government, notwithstanding that the policy of the Government has long been to hand over all its own lines to private companies, will be managed by the Government of India, having become a State line. Then, again, if the East Indian Railway is to be brought under the Government of Bengal, it can only be if all the weighty arguments which effected its transfer to India in 1871 no longer apply.

**MR. DUFF-BRUCE'S UMBALLA-DELHI LINE.**—*The Pioneer* writes:—"If the Government of India would like to retaliate in a way for their discomfiture in connection with the working of Mr. Duff-Bruce's Umballa-Delhi Line, they have only to sanction a proposal put forward by the Bombay-Baroda Company for a straight line from Jagadri to Phalera junction. That would tap the downward traffic from a point between Umballa and Saharanpore, and divert it to Bombay instead of Calcutta. But the temptation seems likely to be resisted." The same paper adds:—"By the way, another and almost equally immoral project, recently put forward by a great financial house in London, though not by either of the two greatest houses, has been declined. The projectors offered, in consideration of a 2½ per cent. guarantee, to raise a capital of three millions sterling, and construct a Railway from Benares to Burrakur. It would probably have paid the promoters very well, whilst playing havoc with the earnings of an important section of the East India Line."

**THE TIRHOOT STATE RAILWAY.**—The negotiation between the Bengal and North-Western Railway Company and the Government of India for the transfer to the latter of the Tirhoot system of State Railways on a working lease, which has been in progress for nearly two years, has

fallen through, for the present at any rate, the Bengal Government, in whose hands the Tirhoot lines are, declining to come to practicable terms. *The Pioneer*, to whom we are indebted for this information says: "The history of this negotiation furnishes yet another instance of the inaptitude of the method by which the India Office and the Indian Government, working on different principles, or perhaps none, and as often pulling in opposite directions, continue to muddle the Railway business of the country. In this case the solitary compensation for such an enormous waste of time and labor will go to the Government of Bengal, who appear to have learnt some useful lessons from the management of a private company in the art of working Railways economically, which they will probably be more ready to apply than to acknowledge."

**A WANT IN SIMLA.**—We learn that tiles as roof covering are no longer in such favor in Simla as heretofore. Several buildings so covered have been found to leak considerably; and in some instances corrugated iron sheeting is to be substituted for the present tile covering. There are various opinions as to the cause of the defect. Some denounce tiles in general as unfit for roofing; while others maintain that the question lies in the particular style of manufacture used, and the manner of laying them on the roof. There are varieties found to be perfectly successful, and, again, others that invariably turn out failures. Those of the Town Hall appear to be proof against rain, as it is said the present leakage of the roof of that building is caused by some defect in the gutters; strange to say they are not equally satisfactory in winter. Being suspended on battens by catches at one end, it seems the snow is liable to drift between them and find its way to the interior of the building. It is a pity some improvement cannot be effected in the manufacture and laying of tiles, as they form a much more attractive roofing than grey corrugated iron.

**INDUSTRIAL PROGRESS IN BURDWAN.**—The Burdwan Division is making good industrial progress, though some old industries are being pushed into the background. In his latest administration report, the Commissioner, under the head of manufactures and mines, states:—"In spite of the importation of cheap European piece-goods, cotton is still woven by local weavers in every district. As a rule, they know no other work, and cling to their ancestral business to obtain a precarious means of living. This industry is, however, on the wane, as the weavers cannot compete with Manchester in the production of cheap goods. In Burdwan a revival in this industry has been noticed in the last two years; but generally, although those who can afford them prefer the country cloths which are of a better texture and more durable, the cheapness of Manchester goods drives the local manufacture out of the market." On the other hand, it is satisfactory to see that the paper mills at Bally, and Messrs. Burn and Co.'s pottery works at Ranee-gunge, shew healthy development. Large employment for labor is found in the silk industry, in the jute and cotton mills which stud the banks of the River Hooghly, and in the mines of Ranee-gunge, which yielded last year a great increase in the outturn of coal. In consequence of the extensive use of machinery, and of the necessity of bringing the boilers in use under more systematic inspection than had hitherto been found possible, it was deemed expedient to extend the application of the Steam-boilers Act III. (B. C.) of 1879 to the sub-division of Ranee-gunge.



**PUBLIC WORKS IN WESTERN INDIA.**—The report of the Public Works Department, Bombay Presidency, for the year 1887-88, shews that the total expenditure in all branches was Rs. 63,47,263. Of this total, military works absorbed Rs. 9,56,360. The published details deal only, with such matters as barrack extensions and repairs, Commissariat buildings, cantonment works, &c. The most important subject, that of Coast Defences, is to be dealt with by the Inspector-General of Military Works in a separate report, a document which will presumably not be made public. As regards Civil Works, there is no need for official reticence. The total expenditure, Imperial and Provincial, was Rs. 53,90,903, the disbursements being roughly as follows:—New Works 24½ lakhs, repairs 18 lakhs, establishment 10½ lakhs, plant and tools ½ a lakh. Far and away the most important operations were connected with the extension of communications. Considerable progress was made during the year with the construction of Railway feeders, this class of work going on in many districts throughout the Presidency. Bridge-making was also engaged in with activity. The two most important works of this class were a bridge over the Indrayani River at Indori, Poona District, which was completed at a total cost of Rs. 77,930, and a bridge over the Dhadhar River, on the road from Broach to Jambusar, which will connect the Jambusar Taluk and its rich cotton area with the other parts of the district—it is now cut off from communication for five months of every year—and when finished, will cost 1½ lakhs of rupees.

**"IMPARTIALITY AND INJUSTICE."**—The *Civil and Military Gazette* says that some people, and most Engineers, are aware that there are two professional papers published in Calcutta, and that the proprietors of one of these papers, appealed to the Government of India for aid, on the plea of their publication proving of great service to the important class in this country to which it was particularly addressed, and that the Department of Public Works eventually responded by becoming subscribers for copies to the value of Rs. 4,000 a year. To use our contemporary's own words "Upon this MR. PAT. DOYLE, the proprietor of *INDIAN ENGINEERING*, which was started after its contemporary, protested, first to the Public Works Minister and then to the Viceroy; his Excellency's Private Secretary replying that that Department had determined to take in a high-class journal in the interests of its chief officers, that the selection of the journal to be patronized was left to the decision of experts, and that it was competent for the Department to do as it had done. Thereupon MR. DOYLE has memorialized the Secretary of State. The very fact, he says, that the favored journal did not pay goes far to prove that it did not please the Engineering profession. His own paper, he asserts, is cheaper and better. About the better we hold no opinion; but he only asks a fair field in which to prove it so. There is, no doubt, something to be said for MR. DOYLE'S views." We may add that other papers think so too, and that we have the sympathy of the profession in the matter. The true history of the jobbery has, however, yet to be set forth—viz., the misrepresentations made to Sir Charles Elliot; the influences brought to bear on that weak-minded Minister for Public Works, who had not the moral courage to recede from a false position even after he was set right not only by ourselves, but by the opinion of the Finance Department; but —*verb. sap.*!

## Current News.

THE Manora breakwater red light at Kurrachee has been carried away, and will be replaced after the monsoon.

THE Railway Conference meets at Simla early next month, and not at the end of this month as has been stated.

AN application has been submitted to Government for a loan of ten lakhs of rupees for the Agra Water-Works project.

THERE are four breaks altogether on the North-Western Railway, two on the Sind-Sagar line, one near Multan, and one in the Bolan.

THE Straits Settlements have followed the example of the mother-country, and legislated against the fraudulent use of trade-marks.

THE ceremony of the opening of the Cotton Mill at Calicut was held on the 15th instant, and attracted a large gathering of sight-seers to the spot.

THE office of the Executive Engineer in charge of the new Viceregal Lodge, Simla, was completely burnt down last week, but the records were saved.

THE silting-up of the Hidgli Tidal Canal is a standing complaint. The Government of Bengal has at last sanctioned Rs. 40,000 for the improvement of the canal.

THE competitive trial of machines and processes for the preparation of Ramie and Rhea fibre, which was notified to be held at Paris on the 15th August, has been postponed till the 25th September 1888.

FOR some time past, there have been symptoms of a cyclonic disturbance in the Bay, and early on Friday morning, last week, Calcutta was visited by a storm, which fortunately did not prove very destructive.

THE Government of Bengal has sanctioned an outlay of Rs. 20,000 for the construction of additional buildings for the use of the Midnapur Collectorate, and an outlay of Rs. 25,000 for a like purpose at Balasore.

THE country on both sides of the river Hooghly from Diamond Harbour up has been flooded by the abnormal rains, and in many places the whole appearance of the river channel was altered beyond recognition.

THE Government of Bengal has sanctioned the expenditure of Rs. 20,000 for the repairs to the Nawab Abdeen's palace at Murshidabad, and Rs. 5,000 to restore the makbara of Moorshed Koolie Khann at Khatra, it being in a dilapidated condition.

MR. TURNER, Agent to the Governor of Madras in Vizagapatam, has made strenuous efforts to induce the Government to adopt a liberal programme of works for opening up communications between the coast districts and the Vizagapatam Agency tracts.

HEAVY floods reported on the Brahmini and Byturni rivers. The water is higher than has ever been recorded, and the country is covered with from three to four feet of water. The rice crops are damaged, and the water level is steady. The roads are under water.

INTENDING exhibitors at the forthcoming Exhibition at Mysore are officially informed that an agency has been constituted for receiving and taking care of and returning exhibits on behalf of exhibitors who are unable to attend in person or employ independent agents.

Sir Henry Morland has served a notice on the authorities of the G. I. P. Railway Company, claiming one lakh of rupees damages for the injuries received by him in consequence of their negligence in not providing lights, &c., on the road where his recent accident took place.

AN accident of a rather severe nature occurred to a goods train in a tunnel named Gundakinduff between Kuchali and Baberkuch stations on the Sibi-Sharigh section of the Sind-Punjab State Railway; resulting in loss of life. The damage to vehicles, &c., was considerable. Accidents on this Railway have been of rather frequent occurrence.

THE latest fad of Holkar has been the electric light. An engine with all the necessary apparatus, arrived from Bombay and a considerable portion of the lamps, &c., had been erected, when suddenly H. H. stopped the work. So the whole of the plant has been taken up and returned to Bombay, the Maharaja paying ten thousand rupees for his little freak.



## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

### PLATELAYING.

SIR,—In reply to Mr. F. J. Preston's letter, inserted in your issue of 18th instant, I would advise that gentleman to procure a nicely written little work on rudimentary platelaying called "The Platelayer's Companion," by Henry Drake, to be had at the Education Society Press, Byculla, Bombay.

INSPECTOR, WAY AND WORKS, B. N. RAILWAY.

### A SUGGESTION.

SIR,—It would be a very great convenience to all those who take in your Journal were you to prepare a neat cover every year in which one could have his numbers strongly bound—similar to that prepared for "Sunday at Home" and "Leisure Hour."

BELAL, DISTRICT RAIFORE, C.P.; }  
August 23, 1888.

J. B.

[Our publisher would doubtless be glad to supply "covers" for binding at a moderate cost on sufficient inducement.—ED., I.E.]

### ASPHALTE FLOORS.

SIR,—If among the readers of your Journal there are any who have had practical experience in the laying of asphalt floors, and who will impart some of their knowledge to others, they will confer a great boon. There are others, like myself, who are particularly desirous of learning how an asphalt floor can be laid without presenting those unsightly lines which remind one of a badly soldered plumber's joint. Owing to the usually adopted method of laying the asphalt when in a plastic state in strips about 18" wide and of endeavouring to fuse the joints of contiguous strips by passing a heated iron over the seams, these ugly marks are left on the floor surface, and a useful material like asphalt is often rejected on account of this disagreeable appearance. It would be worth knowing whether these seam-marks can be avoided or obliterated, and also whether, and how a whole room could be laid in a single strip.

AN ENGINEER.

### O TEMPORA! O MORES!

SIR,—It has been brought to my notice that a correspondent of your weekly Journal, in a letter, published in your issue of the 30th June last, has, by using my *nom de plume*, "*Britannicus*," given me the credit of his well-written, and very proper protest against the desecration of the Willoughby tablet over the old magazine gateway at Delhi. Whilst thanking him for the compliment, I beg to suggest whether it would not be better for him, in his future letters, to adopt some other *nom de plume* than that of "*Britannicus*," already well-known as that of the author of about a hundred letters in opposition to "The Ilbert Bill," published by *The Englishman* between March 1883 and March 1884, and as that of the author of letters upon Assam affairs, published by *The Englishman* in 1885-86, and by *The Indian Planter's Gazette* in 1886-87, and still used by me as my *nom de plume* in my letters to the last named Gazette.

BRITANNICUS.

CACHAR; August 22, 1888.

### CEMENTS.

SIR,—It would be a boon to many if a reliable cement could be found for the joints of tobacco pipes. Most meerschaums are made with a bone tube joining the amber to the clay, and this invariably comes out. I have sent pipes to professional repairers in Calcutta and other large towns, and I have never had a satisfactory repair.

The saliva mixed with nicotine seems to dissolve every cement. I have tried burnt alum, plaster of Paris, patent cements (chiefly isinglass and acetic acid), white of egg, Portland cement, varnish, &c., &c., but nothing seems to hold, and I doubt if any reliable cement is known to the trade, or if so, it is not universally used. There are still a few more, such as a solution of India-rubber, but I would prefer some one else's experience. My latest experiment culminated this morning in the partial destruction of a fine eagle claw pipe lately imported.

BASSEIN, BURMA; }  
August 14, 1888.

NICOTINE.

## THE FAILURE OF THE KALI NADI AQUEDUCT.

### I.

SIR,—I have read with considerable interest the two articles which appeared in your Journal of the 23rd June last, and the 18th August (instant), and from the data given have calculated the discharge of the Kali Nadi River when in extraordinary flood, and unless the information given is incomplete or in some way misleading, I cannot believe the discharge to have been as great as that stated in both the articles, viz., 130,000 and 125,000 cubic feet per second, respectively.

The shape of the catchment basin is described as a rectangle whose length is five times its breadth. This is, I presume, only a general description, and for absolute accuracy of calculation the outline to scale should also be furnished. Again the country is said to be flat, and the soil very sandy. In addition to this I think the data would be more clear and useful if it were stated whether any portion of the drainage basin was covered with loose sand, or whether the soil was a sandy clay, as is sometimes used for brick-making; and a longitudinal section, or the fall in unity, of the bed of the river at site, and a cross section shewing the depth of water given.

Finally I would ask if there is any probability of a portion of the discharge which washed away the Nadrai viaduct, having been due to overflow from the Ganges, or some adjacent drainage basin.

TANSA, viâ ATGAON STATION, G. I. P. RY.; }  
August 21, 1888.

E. C. HAWKES.

## THE FAILURE OF THE KALI NADI AQUEDUCT.

### II.

SIR,—The very interesting note made by Mr. Craig anent "failure of Kali Nadi Aqueduct," published in your last issue, does indeed bring about results corresponding with those arrived at in the preparation of the new sanctioned design. But has what is requisite to avert its fate of 17th July 1885 been provided for? Colonel Dickens' formula, which has been experimentally proved in many instances to establish figures rather under than above actual probabilities, will make out the discharge to be 282,150 cubic feet. The sanctioned design, however, adverted to in your issue of 23rd June, only provides for a floor discharge of 140,000 cubic feet. Our experience of the Sonthal country for the last 13 years, where annual rainfall does not exceed 40 inches, has made us alter Colonel Dickens' co-efficient 825 to 1,000. This leads me to apprehend that the discharge of 160,000 cubic feet, now assumed, has been under-rated. According to Colonel Dickens, the factor of discharge per square mile of catchment area would be 118 cubic feet per second, very near double of what has been provided for.

Is Rankine's factor of 40 cubic feet per second per square mile applicable in this country (India)? On the 15th instant, 6 inches of rain fell here (Dumkah) in only 3 hours' time, and the result was unlooked for damages to many of our works—setting recent hydraulic calculations at naught. This leads us therefore to think that a ventage of 8 square feet per square mile of catchment basin, laid down by Rankine, is not adequate for India, where rainfall in 24 hours could be so heavy.

A. K. MITRA,  
District Engineer.

DUMKAH,  
SONTAL PERGUNNAHS; }  
August 24, 1888.

## CANADA AND INDIA: A COMPARISON.

SIR,—I have read with much interest your interesting article on the Canadian Pacific Railway and am induced to set forth some facts and figures by way of comparison between the "Dominion" and India. Canada is a poor country even as India is, although for a diametrically opposite reason. The Dominion lacks population; India has a superabundance of it. *Voilà tout*. But Canada is doing what in it lies to improve its position, has borrowed a leaf from the story of Railway progression in the adjoining United States; is fast getting full of manufactories, trade improvements, means towards national salvation, from utilitarian points of view. And the reason? There are many reasons, over and above a national sort of instinct for insurances against Providence. One of them is national "push," energy, force of character. It does not matter much by what name you call it. Another, a more immediately relevant one, although hinging on the other, is Government approval, patronage, support.

There is a special Railway department in India likewise, but it is Government affiliated and practically irresponsible—a differential item of management that is apt to have considerable effect on yearly accounts of profit and loss.

The first Canadian Railway opened in 1837, ran from La Prairie, a small town 7 miles from Montreal, to St. Johns, and was evidently a very "one-horse" affair. Railway construction really



began in Canada, to practical intent and purpose, in 1860. Once begun it went on swimmingly. At the end of the year aforesaid, some 2,000 miles of track had been completed.

In 1866, the earnings of 2,150 miles of open line were 11½ million dollars, against a working expenditure of 6½ millions, meaning practically a 5 per cent. dividend, doubtless comfortable to the souls of shareholders.

In 1875, the length of mileage advanced to the figures 4,826, owing, we are told, to "Completion of Works in progress on the Great Western, Inter-Colonial, Prince Edward Island, and other Railways."

In 1886, the length of mileage was 10,697 miles; the length *id est* over which trains were actually running for hire. It is noteworthy that between 1867 and 1886, population on the line of Railway followed, advanced from 3,400,000 to nearly 5,000,000; and the annual trade—inter-provincialisms excluded—from Dollars 131,027,532 to Dollars 189,675,875.

It is not altogether a pleasant consideration to an Indian Engineer to reflect that Canada has beaten India hollow in the race for Railway progress, but consolation may perhaps be found in the flimsy, ephemeral nature of their laying down and appurtenances.

#### PERPETUAL MOTION.

#### WESTERN BENGAL RAILWAY.

Sir,—In INDIAN ENGINEERING of the 18th August 1888, I see an article headed Western Bengal Railway, signed "F. P.," passing severe comments on Sir Bradford Leslie's project, the Western Bengal Railway.

I am not surprised at seeing letters condemning that project; for if such a line were constructed, it would seriously interfere with the big dividends now made by the East Indian Railway.

Nor is it unreasonable for the Oudh and Rohilkhand Railway to desire to share the profits, especially of the goods they bring to Benares, *viz.*, 100,000 tons, which is handed over to the East Indian Railway to swell its traffic. The lower run from Benares to Calcutta will be a greater profit, than the short upper run in Oudh; besides, they are certain to pick up some traffic in goods generally, and a large traffic in coal, which must mean cheap working, and full coal trains, to compete with the East Indian Railway.

"F. P." says the Grand Chord Line (Grand Trunk Road Line) diminishes the distance from Benares to Calcutta 60 miles; as measured off on the map, he may be correct, but that is misleading. I examined the whole line of country along the Grand Trunk Road, and for many miles east. On this route the road rises from about 400 feet above sea-level to 1,300 feet and 1,400 feet, and then falls to a little over 400 feet. The ascent and descent is over 900 feet; and in some places the gradient on the road was 1 in 25; at which places the line would have to be lengthened more than four times the present road. In Keonjhar on the Benares-Cuttack-Poorie Railway project, we had a similar descent from the valley of Keonjhar to the plains of Cuttack. The entire descent in 30 or 40 miles was not over 800 feet, and yet we had to increase the line by 15 miles; heavy cuttings, tunnels and embankments were encountered.

In another project I was engaged on, the Gya-Palamow Railway Survey, to get down 200 feet on an easy road incline we had 4 miles of 1 in 100; in our estimates, the cuttings alone produced 120 lakhs of cubic feet, mostly in crystalline gneiss, quartz, and granite. How much think you it would cost to excavate such cuttings?

The Grand Trunk Road project runs on sidelong hill spurs and flats for 30 to 40 miles up and the same down an ascent and descent of 900 to 1,000 feet. Until such a line were located and estimated, the lines already located and estimated should be our guide. Taking these as a guide, the Grand Trunk Road project would have to be increased by 30 miles. This would leave it shorter than the Western Bengal Railway project by only 11 miles; the greater number of miles of 1 in 100 that would have to be used on the Grand Trunk Line would more than counterbalance any difference in length.

With reference to "F. P.'s" remarks about the Western Bengal Railway project having to pass through hills 2,000 feet high, the Dominikoh hills are 2,000 feet high; and from the outside seem to be an unbroken barrier; yet there is a way through, varying in breadth from 8 miles to ½ mile; the total ascent in 30 miles is only 160 feet, therefore until the Western Bengal Railway project is surveyed, laid out and estimated, no opinion or decision can be come to. It is the duty of Engineers to avoid high hills.

In Manbhoom, Singbhoom, and Keonjhar, there are ranges of hills, some of them rising to 3 or 4,000 feet, but we gave them a wide berth, and found that "distance lends enchantment to the view."

"F. P.," however, may be assured on one subject, that the Bhaugulpore-Nonihaut Line project, not only has coal beds in the country it traverses, but all along its length on the east the Dominikoh coal crops out, and here if 120 lakhs of maunds were removed annually for 2,000 years, the coal would scarcely be exhausted. A 24-mile branch from the Bhaugulpore-Nonihaut project into No. 1 (Eastern) Section of the Dominikoh, will take them into a coal country with just 10 to 20 times that quantity of coal, and give 1,200 lakhs of maunds for 2,000 years;

but to work the deep coal of this section heavy machinery and a large capital would be required.

P. BURKE.

August 27, 1888.

#### HOT AIR ENGINE.

SIR,—I notice in your issue of the 18th August, among other valuable information, furnished by your Burma Correspondent, a description of Gibbs' Hot Air Drying Apparatus, that is in use in connection with one of the rice mills; the duty of which is said to consist in supplying or circulating hot air through the mills, as a counteractive against the excessive damp existent there.

The description of the apparatus does not accord with that of a Hot Air Engine, which is understood to be a contrivance for generating and transmitting motive power to machinery, as does the Steam Engine.

And as "Hot Air's" inquiry has reference to the Hot Air Engine and not Hot Air Drying Apparatus, the otherwise valuable information might prove misleading to him. Of course, I may be wrong in my assertions, and it is just possible that later improvements or changes in the design of Hot Air Engines, will prove me to be so; but in the case under review, I am being entirely guided by what the designation of the apparatus, its description and mode of action convey to my mind.

The scientific, or general principle on which thermo-dynamic motors act, is the well recognized theory of expansion and contraction of substances under extremes of temperature. The Hot Air Engine being one of that class, the power-generating substance or agent, air, is exposed to heat, or converted into power and utilized in the most practicable method that mechanical skill has helped in its application to purposes of general usefulness.

It works much in the same manner as a Steam Engine, using air, instead of water, for its power-generating agent. It consists of an air boiler or combustion chamber, in which the air comes in direct contact with the fuel; the firing being controlled by means of double valves to prevent the loss of heat. But the method that is more in accordance with modern practice, and the theory of its economical working, involves the introduction of combustible gas amongst the air in the combustion chamber, which, when ignited by some suitable means by an electric spark or otherwise, the explosion heats the air, which process goes on until the required pressure has been attained. The power thus generated, is liberated into the air cylinder, which corresponds with that of the steam cylinder; and acts upon the piston in moving it up and down. The Engine being furnished with eccentrics or cams to regulate the admission of the heated air, and the release of the exhausted air, which, on its way, passes through a regenerator. The latter might be compared to an economiser of a Steam Engine, or what would be better still, a condenser; but the action of the regenerator being converse to that of the condenser, the cold air passing into the combustion chamber, takes away with it the heat of the exhausted air imported to the tubes of the regenerator.

The piston of this class of Engine carries a truck, typical of that known as the Trunk Engine, but different in its application and performance of its duties.

The trunk leaves an annular space around it, or between it and the air cylinder, in which it works; it having the necessary valve connections with the outside air and the combustion chamber. This arrangement supplies the place of a feed pump, or what would be a better term, serves as an air pump, taking in air in its downward stroke, and forcing the same into the combustion chamber in its upward stroke.

Thus the Engine performs its duties more or less like a Steam Engine; the factors of difference being in this Engine, its economy where small motive power is required, noiseless, not requiring skilled attendance, safe, comparatively speaking, light in its construction, and uniform in its speed or motion.

It might be found in mints driving the *rupee weighing machine* (I forget its performance)—the acme of mechanical precision, with electricians and other places where its advantages have proved a recommendation for its employment.

It is not the Engine for driving mills or factories.

In conclusion, I may remark that, since your correspondent "Hot Air" is so near Calcutta, he might with advantage spend a few hours at the various Engineering firms' show-rooms or works and other likely places, where his success in coming across one will remove much difficulty from his path, whether he be an Engineer or an investor.

C. L. PHILLIPS.

THE Italian Chamber of Deputies has voted by a large majority the Bill for the construction of nearly 2,000 miles of Railway, chiefly in Southern Italy.

A PLAN has been prepared for the construction of a palace at Merv for the use of Imperial guests and important officials. The palace will be built in the European style, and will be fitted up with all the luxury of one of the palaces of the capital, made in the Stores Department.



## General Articles.

### TYPES OF IRON GIRDER BRIDGES, INDIAN MIDLAND RAILWAY.

As promised, we furnish the first of a series of Plates giving details of the main girders of these Bridges. The drawings are self-explanatory. The annexed Plate refers to the Jumna Bridge at Kalpi, described in our last issue.

### NEW TABLES FOR CALCULATION OF PIPES.

BY LALA GANGA RAM, C.E.,

Executive Engineer, P. W. D., Punjab.

A SANITARY Engineer has often to make the following calculations with regard to the size of pipes:—

(a.) Given the length of a pipe, the discharge, and the head available, to find the diameter.

(b.) Given the length of a pipe, the discharge and the diameter, to find the loss of head.

To solve these problems, there are several formulæ and tables given in various Hydraulic works. The author has also attempted to facilitate these calculations by framing two tables, A and B, herewith appended, which he hopes would be found time-saving and useful. Their novelty lies in the fact that their results involve an important function, namely, *velocity*; which for several reasons must be kept within certain limits. The maximum velocity of flow that should be allowed in supply and distribution pipes is given in Fanning's Treatise on Water-Supply (see page 508, edition of 1882), reproduced below.

Diameter in inches.	4	6	8	10	12	14	16	18	20
Maximum velocity in feet per second...	2.5	2.8	3.0	3.3	3.5	3.9	4.2	4.5	4.7

For the purpose of reference, call this table C.

**Notations.**—The following notations and units of measure are used throughout these calculations:—

Discharge in cubic feet per minute.

Velocity in feet per second.

Length in feet.

Area in square feet.

Loss of head per 1,000 ft., for which symbol  $f_h$  is used.

By diameter of pipe is meant the internal bore in inches.

*Explanation of Tables A and B.*

(i).—Table A.

Gives at a glance the velocity in feet per second corresponding to a certain discharge for a pipe of given size. It is based on the following formula:—

If  $Q$  = Discharge in cubic feet per minute.

$A$  = Area in square feet.

$V$  = Velocity in feet per second.

or  $60 V$  = Velocity in feet per minute.

$$\therefore Q = 60 A V$$

$$\therefore V = \frac{Q}{60 A}$$

**Example.**—Find the value of  $V$  for an 11" pipe discharging 84.96 c. ft. per minute.

Opposite 11" in the column of 8 read 20  $\therefore$  for 80 2.0

" " " 4 " 10  $\therefore$  for 4 .10

" " " 9 " 23  $\therefore$  for 9 .023

" " " 6 " 15  $\therefore$  for .06 .0015

$\therefore$  Total Velocity = 2.1245

**Example (a).**—Given Discharge = 100 c. ft. per minute; Head available = 40 ft.; Length of pipe = 12,000 ft.; Find the diameter.

If 40 ft. is the head for 12,000 ft.; the same per 1,000 would be  $\frac{40}{12} = 3.3$ .

From Table A we see that for a 9" pipe, velocity corresponding to a discharge of 100 c. ft. = 3.8 (since .38 is for 10) and for a 10" pipe, velocity corresponding to the same discharge = 3.0.

$\therefore$  10" is the proper size fulfilling the conditions of maximum in Table C.

$V$  being 3',  $V^2 = 9$ .

From Table B in line with 10" and in the vertical column

of 9, read 5.4, i.e., the loss of head per 1,000 is 5.4 ft. But the head available is only 3.3 per 1,000; therefore the size should be increased.

Try 11"; by Table A,  $V$  for 11" corresponding to a discharge of 100 = 2.5

$$\therefore V^2 = 6.25.$$

By Table B, for 11" pipe

value of $f_h$ when $V^2 = 6$	is	...	3.27
" " = 2	"	...	.108
" " = .05	"	...	.0272

Total ... 3.405

Head available being 3.3, 11" is barely sufficient.

The same operation can of course be reversed if we want to find the discharge for a given velocity.

(b).—Table B.

Having found  $V$ , find the value of  $V^2$  from Tables of Squares in Molesworth; and then Table B will give at a glance the value of  $f_h$  (loss of head per 1,000 ft.) corresponding to a given value of  $V^2$  for pipe of a given size. This table is thus investigated:—

Eytelwein's formula, on which Beardmore's Tables are based, is  $V = \frac{50 \sqrt{hd}}{\sqrt{L}}$

Evidently this co-efficient of 50 is based upon certain experiments. Fanning after comparing the different experiments, gives a co-efficient of 50 for *clean* pipes, 44.8 for *slightly tuberculated* pipes, and 36.63 for *very foul* pipes. Considering that pipes are now-a-days always coated with Dr. Angus Smith's solution, which reduces the chances of tuberculation to a minimum, it would be safe to adopt the second, namely, 44.8 for slightly tuberculated pipes. It will be shewn hereafter, by working an example, that this co-efficient gives results very closely agreeing with the formula given by Box.

Adopting therefore  $V = \frac{44.8 \sqrt{hd}}{\sqrt{L}}$  where  $V$  = velocity in feet per second,  $h$  = head in feet,  $d$  = diameter in feet,  $L$  = length in feet.

Simplifying the above equation  $h = \frac{.0005 \times L \times V^2}{a}$

If  $D$  = diameter in inches =  $\frac{d}{12}$ , and if we take  $V^2 = 1$ ,

$L = 1,000$ , we get  $f_h$  (loss of head per 1,000) =  $\frac{6}{D}$ ; hence

Table B.

**Example (b).**—Given Discharge = 100 c. ft. per minute; Length = 12,000 ft.; Diameter = 12 inches; Find the loss of head.

By Table A, opposite 12" in the column of 10  $V = 2.1$

$\therefore$  for 100,  $V = 2.1$

$$\therefore V^2 = 4.41$$

By Table B, opposite 12" in line with 4  $f_h = 2.00$

"	"	.4	.20
"	"	.01	.005

$\therefore$  Total loss of head per 1,000 for  $V^2 = 4.41$ , is 2.205

12

$\therefore$  for 12,000 ft. 26.46 ft.

Let us check this result by Box's formula.

$$H = \frac{G^2 \times L}{(3d)^5}$$

Where  $H$  = Head in feet.

$G$  = No. of gallons per minute which in this case is  $100 \times 6.25 = 625$ .

$L$  = Length in yards, which in this case is 4,000.

$d$  = Diameter in inches, which in this case is 12.

$$\therefore \log H = 2 \log 625 + \log 4,000 - 5 \log (3 \times 12)$$

Simplifying,  $H = 26$  nearly.

Thus it will be seen that the results obtained by Table B very closely agree with those derived from Box's formula.

G. R.











TABLE A.

Bore in inches.	Sectional area of pipe in feet.	Velocity in feet per second corresponding to a discharge of c.ft. per minute.									
		1	2	3	4	5	6	7	8	9	10
½"	·00137	12·16	21·33	33·49	48·66	60·82	72·99	85·15	97·32	109·48	121·65
¾"	·0031	5·38	10·75	16·12	21·50	26·88	32·25	37·63	43·01	48·38	53·76
1"	·0055	3·03	6·06	9·09	12·12	15·15	18·18	21·21	24·24	27·27	33·33
1¼"	·0108	1·54	3·08	4·62	6·17	7·71	9·19	10·80	12·34	13·88	15·43
1½"	·01227	1·36	2·71	4·07	5·43	6·79	8·15	9·50	10·86	12·12	13·51
1¾"	·0167	1·00	1·99	2·99	3·99	4·99	5·98	6·98	7·98	8·98	9·98
2"	·0218	·76	1·53	2·29	3·06	3·82	4·59	5·35	6·11	6·88	7·64
2½"	·0341	·49	·98	1·47	1·95	2·44	2·93	3·42	3·91	4·40	4·89
3"	·0491	·34	·68	1·02	1·36	1·70	2·04	2·38	2·71	3·05	3·39
3½"	·0668	·25	·50	·75	1·00	1·25	1·50	1·75	2·00	2·25	2·50
4"	·0872	·19	·38	·57	·76	·95	1·15	1·34	1·53	1·72	1·91
4½"	·1104	·15	·30	·45	·60	·75	·90	1·06	1·21	1·36	1·51
5"	·1363	·12	·24	·37	·49	·61	·73	·85	·98	1·10	1·22
5½"	·1650	·10	·20	·30	·40	·50	·61	·71	·81	·91	1·01
6"	·1963	·08	·17	·25	·34	·42	·51	·59	·68	·76	·85
6½"	·2304	·07	·14	·22	·29	·36	·41	·51	·58	·65	·72
7"	·2672	·06	·12	·19	·25	·31	·37	·44	·49	·56	·61
7½"	·3068	·05	·10	·16	·22	·27	·33	·38	·43	·49	·54
8"	·3440	·05	·097	·14	·19	·24	·29	·34	·39	·43	·48
8½"	·3942	·04	·08	·12	·17	·21	·25	·29	·34	·38	·42
9"	·4418	·04	·07	·11	·15	·19	·22	·26	·30	·34	·38
9½"	·4922	·03	·07	·10	·13	·17	·20	·24	·27	·30	·34
10"	·5454	·03	·06	·09	·12	·15	·18	·21	·24	·27	·30
10½"	·6013	·03	·05	·08	·11	·14	·17	·19	·22	·25	·28
11"	·6600	·02	·05	·07	·10	·13	·15	·18	·20	·23	·25
11½"	·7213	·02	·04	·07	·09	·11	·14	·16	·18	·21	·23
12"	·7854	·02	·04	·06	·08	·10	·13	·15	·17	·19	·21
13"	·9216	·018	·036	·054	·072	·090	·108	·126	·144	·162	·18
14"	1·0688	·016	·031	·047	·062	·078	·936	·109	·124	·140	·156
15"	1·2272	·014	·027	·041	·054	·068	·081	·095	·109	·122	·136
16"	1·3760	·012	·024	·036	·048	·061	·073	·085	·097	·109	·121
17"	1·5768	·011	·021	·032	·042	·053	·063	·074	·085	·095	·106
18"	1·7672	·009	·019	·028	·038	·047	·057	·066	·075	·085	·094
19"	1·9688	·008	·017	·025	·034	·042	·051	·059	·068	·076	·085
20"	2·1816	·0077	·015	·023	·031	·038	·046	·054	·061	·069	·077
21"	2·4052	·0069	·014	·021	·028	·035	·042	·049	·056	·062	·069
22"	·264	·0063	·013	·019	·025	·032	·038	·044	·050	·057	·063
23"	2·8852	·0058	·012	·017	·023	·029	·035	·040	·046	·052	·058
24"	3·1416	·0053	·011	·016	·021	·026	·032	·037	·042	·048	·0



TABLE B.

Bore in inches.	Loss of head ( $f_h$ ) per 1,000 l.ft. corresponding to $V^2 =$									
	1	2	3	4	5	6	7	8	9	10
$\frac{1}{8}$ "	17	24	36	48	60	72	84	96	108	120
$\frac{3}{8}$ "	11	16	24	32	40	48	56	64	72	80
1"	11	12	18	24	30	36	42	48	54	60
1 $\frac{1}{8}$ "	4.8	9.6	14.4	19.2	24	28.8	33.6	38.4	43.2	48
1 $\frac{1}{4}$ "	4	8	12	16	20	24	28	32	36	40
1 $\frac{3}{8}$ "	3.43	6.85	10.28	13.71	17.14	20.57	24.00	27.42	30.85	34.28
2"	3	6	9	12	15	18	21	24	27	30
2 $\frac{1}{8}$ "	2.40	4.8	7.2	9.6	12	14.4	16.8	19.2	21.6	24
3"	11	4	11	15	10	12	14	16	18	20
3 $\frac{1}{2}$ "	1.71	3.42	5.14	6.85	8.57	10.28	12.00	13.71	15.42	17.14
4"	1.50	3.00	4.50	6.00	7.5	9.00	10.5	12.00	13.5	15
4 $\frac{1}{2}$ "	1.33	2.65	4.00	5.33	6.66	8.00	9.33	10.66	12.00	13.33
5"	1.20	2.4	3.6	4.8	6.0	7.2	8.4	9.6	10.8	12
5 $\frac{1}{2}$ "	1.09	2.18	3.27	4.36	5.45	6.54	7.63	8.72	9.89	10.90
6"	1	11	3	4	11	6	7	11	9	10
6 $\frac{1}{2}$ "	.923	1.84	2.76	3.69	4.61	5.53	6.46	7.38	8.30	9.23
7"	.857	1.71	2.57	3.42	4.28	5.14	6	6.85	7.71	8.57
7 $\frac{1}{2}$ "	.800	1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2	11
8"	.75	1.5	2.25	3.00	3.75	4.5	5.25	6	6.75	7.50
8 $\frac{1}{2}$ "	.70	1.40	2.11	2.82	3.52	4.23	4.94	5.64	6.35	7.05
9"	.67	1.33	2.0	2.66	3.33	4.0	4.66	5.33	6.00	6.66
9 $\frac{1}{2}$ "	.631	1.26	1.89	2.52	3.15	3.78	4.42	5.05	5.68	6.31
10"	.60	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0
10 $\frac{1}{2}$ "	.57	1.14	1.71	2.28	2.85	3.42	4.00	4.57	5.14	5.71
11"	.545	1.08	1.63	2.18	2.72	3.27	3.81	4.36	4.90	5.45
11 $\frac{1}{2}$ "	.521	1.04	1.56	2.08	2.60	3.13	3.60	4.14	4.69	5.21
12"	.50	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
13"	.462	.923	1.385	1.846	2.308	2.769	3.091	3.692	4.154	4.62
14"	.429	.857	1.286	1.715	2.143	2.572	3.000	3.429	3.858	4.29
15"	.4	.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0
16"	.375	.750	1.125	1.50	1.875	2.25	2.625	3.00	3.375	3.750
17"	.352	.706	1.059	1.412	1.765	2.118	2.471	2.824	3.176	3.520
18"	.333	.666	1.00	1.333	1.666	2.00	2.333	2.666	3.000	3.333
19"	.316	.632	.947	1.263	1.579	1.895	2.211	2.526	2.843	3.158
20"	.30	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.00
21"	.286	.571	.857	1.143	1.429	1.714	2.00	2.286	2.571	2.86
22"	.273	.545	.818	1.09	1.363	1.636	1.909	2.182	2.455	2.727
23"	.255	.510	.765	1.019	1.274	1.529	1.784	2.039	2.294	2.55
24"	.25	.50	.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50



## NOTES ON NAVIGATION.

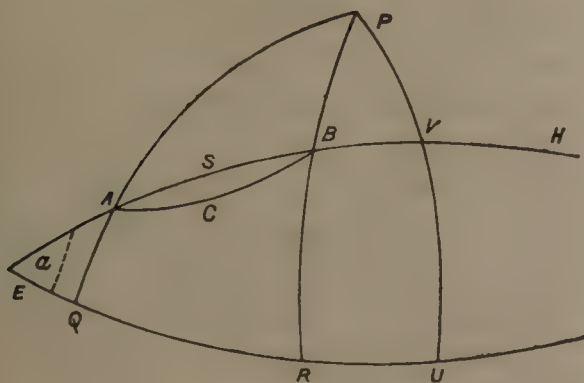
BY A. EWBANK.

## VI.

In the preceding paper we have had some numerical calculations and thence we have drawn inferences in the region of probabilities. We may now strengthen our case by more general reasoning.

We proceed to calculate the course  $\gamma$  for a small arc which is placed anywhere on a given circle which itself occupies any assigned position on the sphere.

Fig. 12.



Thus in fig. 12 E A B is a great circle making with the equator any acute angle  $\alpha$ . A B is an arc of given length and E A is a variable arc defining the position in E V of the arc A B. E A we may call  $s$  and for the small arc A B we use the Greek letter  $\sigma$ .

In our investigations  $\sigma$  will be a small quantity.  $\sigma$  denotes the circular measure of the small arc A B. A quantity  $\sigma$  is defined to be small when  $\sigma$  is large compared with  $\sigma^2$ . In other words we shall wherever convenient neglect  $\sigma^2$  and higher powers of  $\sigma$  in comparison with  $\sigma$ .

$$A Q = l; E Q = \lambda$$

As A B is a small arc Q R will be small. Let  $E R = \lambda + \delta\lambda$ . The latitude of B will slightly exceed  $l$   $\therefore$  we put  $B R = l + \delta l$ . This small increment  $\delta l$  we shall express in terms of  $\delta\lambda$  which is the small increment in longitude. For shortness put  $\delta\lambda = x$ .

By equation (7)

$$\delta\lambda \cot \gamma = x \cot \gamma = \log \left\{ \tan B R + \sec B R \right\} - \log \left\{ \tan A Q + \sec A Q \right\}$$

We shall first express the latitude A Q in terms of the longitude  $E Q = \lambda$ .

$$\text{By (2) } \tan A Q = \tan \alpha \sin \lambda$$

$$\therefore \sec A Q = \sqrt{1 + \tan^2 \alpha \sin^2 \lambda}$$

$$\text{Similarly } \tan B R = \tan \alpha \sin \lambda + x$$

$$\therefore \sec B R = \sqrt{1 + \tan^2 \alpha \sin^2 \lambda + x}$$

$$\therefore x \cot \gamma =$$

$$\log \left\{ \tan \alpha \sin \lambda + x + \sqrt{1 + \tan^2 \alpha \sin^2 \lambda + x} \right\} - \log \left\{ \tan \alpha \sin \lambda + \sqrt{1 + \tan^2 \alpha \sin^2 \lambda} \right\}$$

We must now expand the right hand member by Taylor's theorem in powers of  $x$ .

Let  $\phi(\lambda) = \text{a function of } \lambda$

$$= \log \left\{ \tan \alpha \sin \lambda + \sqrt{1 + \tan^2 \alpha \sin^2 \lambda} \right\}$$

Then the expression  $\phi(\lambda + x)$  denotes

$$\log \left\{ \tan \alpha \sin \lambda + x + \sqrt{1 + \tan^2 \alpha \sin^2 \lambda + x} \right\}$$

Now by Taylor's theorem given in works in the Differ-

ential Calculus  $\phi(\lambda + x) = \phi(\lambda) + x \frac{d}{d\lambda} \phi(\lambda) + \frac{x^2}{2} \frac{d^2}{d\lambda^2} \phi(\lambda)$

+ &c.

As  $x$  is small we neglect the powers of  $x$  higher than  $x^2$ . Thus

$$\cot \gamma = x \frac{d}{d\lambda} \phi(\lambda) + \frac{x^2}{2} \frac{d^2}{d\lambda^2} \phi(\lambda)$$

$$= \frac{d}{d\lambda} \phi(\lambda) + \frac{x}{2} \frac{d^2}{d\lambda^2} \phi(\lambda) \quad (12)$$

$$\text{Now } \frac{d\phi}{d\lambda} = \frac{d\phi}{dl} \frac{dl}{d\lambda}$$

$$\phi(l) = \log(\tan l + \sec l)$$

$$\frac{d\phi}{dl} = \frac{1}{\cos l}$$

$$\therefore \frac{d\phi}{d\lambda} = \frac{1}{\cos l} \frac{dl}{d\lambda}$$

$$= \sec l \frac{dl}{d\lambda}$$

$$\tan l = \tan \alpha \sin \lambda \quad (2)$$

$$\therefore \sec^2 l \frac{dl}{d\lambda} = \tan \alpha \cos \lambda$$

$$\therefore \frac{d\phi}{d\lambda} = \tan \alpha \cos \lambda \cos l \quad (13)$$

$$= \tan \alpha \cos E A$$

by (3)

$$= \cot E A Q$$

by (4)

$$= \cot A$$

(14)

By (13)

$$\frac{d\phi}{d\lambda} = \tan \alpha \cos \lambda \cos l$$

$$= \frac{\tan \alpha \cos \lambda}{\sec l}$$

$$= \frac{\tan \alpha \cos \lambda}{\sqrt{1 + \tan^2 l}}$$

$$= \frac{\tan \alpha \cos \lambda}{\sqrt{1 + \tan^2 \alpha \sin^2 \lambda}}$$

$$\frac{d^2\phi}{d\lambda^2} = \frac{-\tan \alpha \sin \lambda}{\sqrt{1 + \tan^2 \alpha \sin^2 \lambda}} - \frac{\tan \alpha \cos \lambda \tan^2 \alpha \sin \lambda \cos \lambda}{(1 + \tan^2 \alpha \sin^2 \lambda)^{\frac{3}{2}}}$$

$$\text{or } \frac{d^2\phi}{d\lambda^2} = \frac{1 + \tan^2 \alpha \sin^2 \lambda}{\tan \alpha \sin \lambda} \left\{ 1 + \tan^2 \alpha \sin^2 \lambda \right\}^{\frac{3}{2}} = 1 + \tan^2 \alpha \sin^2 \lambda + \tan^2 \alpha \cos^2 \lambda = \sec^2 \alpha$$

$$\text{or } -\frac{d^2\phi}{d\lambda^2} = \frac{\tan \alpha \sin \lambda}{\sqrt{1 + \tan^2 \alpha \sin^2 \lambda}} \cdot \frac{1}{1 + \tan^2 \alpha \sin^2 \lambda} \cdot \sec^2 \alpha = \sin l \cos^2 l \sec^2 \alpha$$

Thus (12) becomes

$$\cot \gamma = \cot A - \frac{x}{2} \sin l \cos^2 l \sec^2 \alpha \quad (15)$$

From this we may obtain  $\gamma - A$ , i.e., the angle at A between the circle and the rhumb line.

$$\tan \gamma - A = \frac{\tan \gamma - \tan A}{1 + \tan \gamma \tan A}$$

$$= \frac{\cot A - \cot \gamma}{\cot A \cot \gamma + 1}$$

Substitute from (15). Thus

$$\tan \gamma - A = \frac{\frac{x}{2} \sin l \cos^2 l \sec^2 \alpha}{1 + \cot^2 A - \frac{x}{2} \sin l \cos^2 l \sec^2 \alpha \cot A}$$

$$= \frac{\frac{x}{2} \sin l \cos^2 l \sec^2 \alpha}{\operatorname{Cosec}^2 A}$$

if we neglect terms involving  $x^2$



$$\text{Thus } \tan \gamma - A = \frac{x}{2} \sin l, \cos^2 l, \sec^2 a, \sin^2 A$$

$$\text{Now by (5) } \cos a = \cos l \sin A$$

$$\therefore \tan \gamma - A = \frac{x}{2} \sin l \quad (16)$$

In the foregoing equation  $x$  represents  $\delta \lambda$  or  $Q R$  of *fig. 12*, where the arc  $Q R$  is represented large for the sake of clearness in the figure.  $x$  is not constant, for  $A B$  as it moves along  $E V$  is constant and  $Q R$  will vary being least near  $E$  and greatest near  $V$ .

By (6) we have

$$\begin{aligned} \tan E Q &= \cos a, \tan E A \\ \text{or } \tan \lambda &= \cos a \tan s \\ \therefore \sec^2 \lambda \delta \lambda &= \cos a \sec^2 s \delta s \end{aligned}$$

$$\begin{aligned} \therefore \delta \lambda &= \delta s \frac{\cos a \cos^2 \lambda}{\cos^2 s} \\ &= \frac{\delta s_1 \cos a}{\cos^2 l} \quad \text{by (3)} \end{aligned}$$

$$\delta \lambda = x \text{ and } \delta s = \sigma. \text{ Thus}$$

$$x = \frac{\sigma \cos a}{\cos^2 l} \quad (17)$$

Thus by (1, 6)

$$\tan \gamma - A = \frac{\sigma}{2} \sin l \cos a \sec^2 l \quad (18)$$

$$\therefore \gamma - A = \frac{\sigma}{2} \sin l \cos a \sec^2 l \text{ approximately.}$$

In this equation  $\sigma$  is a constant. As long as we keep on the same circle  $E V$   $a$  is also constant. Thus in the right hand member of (18)  $l$  is the only variable.

The expression  $\sin l \sec^2 l$  is zero if  $l$  is zero. The expression continually increases with  $l$ . And  $l$  itself increases towards its maximum value, which is the acute angle  $a$ . The equation incidentally informs us that the rhumb line lies south of the great circle arc, for if it were otherwise  $\tan \gamma - A$  would be negative.

The equation shews that as a small arc  $\sigma$  of given constant length travels along a given great circle  $E V$  the deviation between the arc and its rhumb line continually increases.

As long as we can neglect  $\sigma^2$  comparison with  $\sigma$  we may say that at  $E$  the angle  $\gamma - A$  has absolutely vanished, for the factor  $\sin l$  is there zero. To this point we shall subsequently return, because it is connected with the fact that at  $E$  the rhumb line has a point of inflexion.

At present we confine ourselves to noting that the angle  $\gamma - A$  is greatest at  $V$  when the rhumb line becomes a small circle of latitude.

This conclusion is true for any value of  $a$ . In the preceding paragraph the various values of  $\gamma - A$  are compared as we travel along any one given circle  $E V$ .

For any chosen value of  $a$  we have at  $V$

$$\begin{aligned} \tan \gamma - A &= \frac{\sigma}{2} \sin l \sec^2 l \cos a \\ &= \frac{\sigma}{2} \sin a \sec^2 a \cos a \\ &= \frac{\sigma}{2} \tan a \quad (19) \end{aligned}$$

On the equator  $a$  is zero and accordingly  $\gamma - A$  is there zero. This we already knew.

If we take various values of  $a$  and thus compare the maximum value of  $\gamma - A$  for one circle  $E V$ , with the maximum value for another circle  $E V^1$ , we see that  $\gamma - A$  increases as  $a$  increases. If  $a$  becomes  $90^\circ$   $\tan \gamma - A$  becomes infinite. Therefore  $\gamma - A$  is itself  $90^\circ$ . If  $a$  is not exactly  $90^\circ$ , but is nearly  $90^\circ$ , we have  $\gamma - A$  also near to  $90^\circ$ .

If these last results appear difficult to accept, we may consider the matter as follows. When  $a$  becomes  $90^\circ$  our circle  $E V$  is a meridian and  $V$  becomes  $P$ , the north pole. The small arc  $A B$  then lies so that  $P$  is its middle

point. The rhumb line then (as always at  $V$ ) is a small circle of latitude  $A C B$ . The great circle  $A B$  is now the diameter of the small circle. If we move from  $A$  to  $B$  along the rhumb line, we go round the small circle of latitude. If we move on the great circle we go across the small circle on the curved diameter of this small circle. As the meridian diameter of a small circle of latitude cuts the arc at right angles, we see how in this limiting case  $\gamma - A$  becomes a right angle.

We are thus taking the arc  $E A$  not exactly  $90^\circ$  but equal to  $90 - \frac{\sigma}{2}$ . As  $\sigma$  is a small angle we have put  $E A = 90^\circ$  or  $l = a$ .

By (15) we have

$$\cot \gamma = \cot A - \frac{x}{2} \sin l \cos^2 l \sec^2 a$$

and by (17) we have

$$x = \sigma \cos a \sec^2 l$$

$$\therefore \cot \gamma = \cot A - \frac{\sigma}{2} \sin l \sec a \quad (20)$$

In *fig. (12)* we see that by (4)

$$\cot E B R \cot a = \cos E B$$

$$\text{or } \cot B \cot a = \cos s + \sigma$$

$$\text{Similarly } \cot A \cot a = \cos \sigma$$

$$\therefore \cot a (\cot A - \cot B) = \cos \sigma - \cos s + \sigma$$

$$= \sigma \sin s$$

if we neglect higher powers of  $\sigma$

$$\therefore \cot B = \cot A - \sigma \sin s \tan a$$

$$\text{and } \sin l = \sin s \sin a$$

$$\therefore \cot B = \cot A - \sigma \sin l \sec a \quad (21)$$

Comparing (20) and (21) we obtain

$$\cot B = \cot \gamma - \frac{\sigma}{2} \sin l \sec a$$

$$\tan B - \gamma = \frac{\cot \gamma - \cot B}{1 + \cot \gamma \cot B}$$

$$\frac{\sigma}{2} \sin l \sec a$$

$$= \frac{\sigma}{1 + \cot^2 \gamma - \frac{\sigma}{2} \sin l \sec a \cot \gamma}$$

$$= \frac{\sigma}{2} \sin l \sec a \sin^2 \gamma \text{ approximately.}$$

Now  $\gamma - A = \frac{\sigma}{2} \sin l \cos a \sec^2 l$  approximately. Therefore  $\sin^2 \gamma$  must differ from  $\sin^2 A$  by a small quantity.

Therefore in the expression  $\frac{\sigma}{2} \sin l \sec a \sin^2 \gamma$ , we may write  $\sin^2 A$ , for  $\sin^2 \gamma$ ; as in our results we neglect  $\sigma^2$ .

$$\therefore \tan(B - \gamma) = \frac{\sigma}{2} \sin l \sec a \sin^2 A$$

$$\text{Now } \cos a = \cos l \sin A$$

$$\therefore \tan(B - \gamma) = \frac{\sigma}{2} \sin l \sec a \cos^2 a \sec^2 l$$

$$= \frac{\sigma}{2} \sin l \cos a \sec^3 l$$

$$= \tan \gamma - A \quad \text{by (18)}$$

$$\therefore \beta - \gamma = \gamma - A$$

$$\text{or } \gamma = \frac{A + B}{2} \quad (22)$$

In the preceding paper we found that for a particular value of  $a$ , viz.,  $45^\circ$ , and for a particular value of  $A B$ , viz.,  $10^\circ$ , and for a particular position of  $A B$ , viz.,  $E A = \text{zero}$ , we had  $\gamma$  very nearly equal to  $\frac{A + B}{2}$ .

The equation (22) shews us that our numerical result was not an exceptional one, and that we may confidently for all small arcs in all positions of the great circle consider  $\gamma$  as approximately equal to the semi-sum of the corresponding great circle courses.

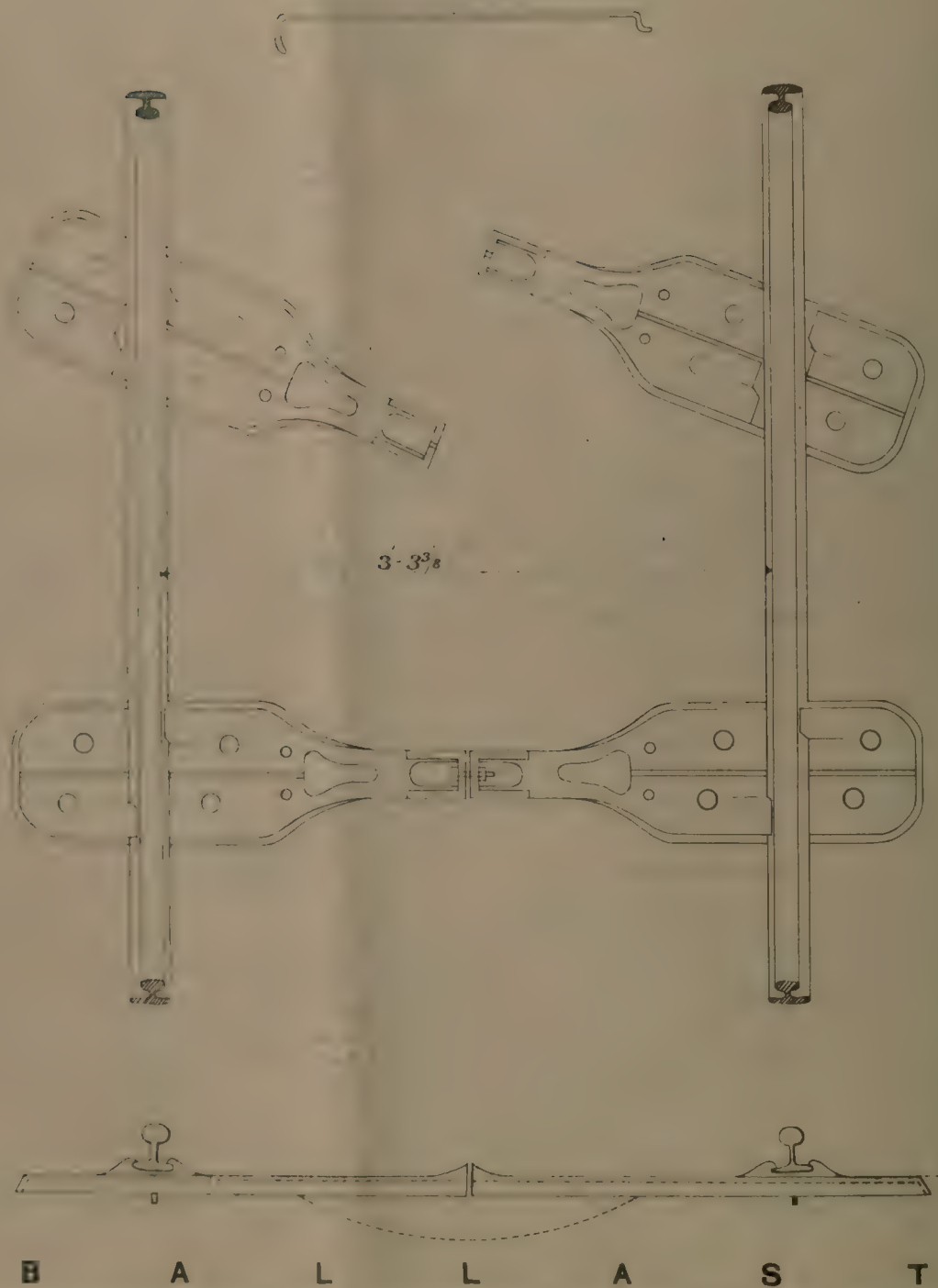






DESIGN FOR CAST IRON SLEEPER  
METRE-GUAGE.

*Tie bar  $\frac{1}{2}$  round iron.*



GEO. E. MOORE, M. INST. C. E.



## DESIGN FOR CAST-IRON SLEEPER FOR METRE GAUGE.

BY G. E. MOORE, M. INST. C. E., DEPUTY CONSULTING ENGINEER FOR RAILWAYS, CALCUTTA.

By reference to the drawing it will be seen that the sleeper consists of two cast-iron plates connected by a bolt, which may be fastened either with a screw nut or with a tapered cotter.

There are no loose rail fasteners, the fixing of the rail being performed by the insertion of the plate under the rail askew, the bringing it square after the rail has dropped between the lugs locking it.

The widening of gauge for curves or other purposes, can be effected by slackening off the bolt to the desired amount and the insertion, if thought necessary, of a washer between the plates. But as the tendency is always to widening of gauge and not the reverse, a washer is not absolutely necessary.

This form of sleeper, a plate with turned down edges, has been selected after much consideration as the best form. It is simple and easily cast. It can be easily packed without opening out the road as with pots and wooden sleepers. It has a good grip of the ballast, and the spy holes provided enable the Inspector to see if the plates have been properly packed and to test the packing by probing with a bar. With ordinary plate sleepers it is noticed that when the sleepers have to be lifted before being packed, the beaters when applied on one side drive the ballast out on the other, which the shallow run round this design will prevent.

It may be objected that the neck of this sleeper is a weak point. Doubtless it is its weakest point, but it is only a matter of more weight to make it as strong as any other part if so desired.

The sleeper has been so designed that if the neck is broken it will be still available for use in sidings or temporary roads by the addition of a round iron tie bar as shewn in the drawing. This tie bar would be inserted in the holes shewn in the plates in a slightly diagonal direction, so as to direct the pull on each plate against the outside lug.

These plates cast without the neck, and used with the round iron tie bars before mentioned, would make a very cheap and efficient road for sidings or temporary lines being easily put in and easily taken up.

G. E. M.

## NOTES FROM HOME.

(From our own Correspondent.)

THE Annual Report of the Board of Trade on the Railway accidents in the United Kingdom during the past year has just been issued, and it shews the wonderful safety which now characterises the working of Railways in the British Islands. Were it not for the disastrous collision at Hexthorpe, which accident was entirely due to the suspension of the block system on this section of the line during the Doncaster race week, no deaths would have been recorded as occurring to passengers in accidents to trains from causes beyond their own control. Including season-ticket holders, the passengers killed are 1 in 35 millions journeys a state of things which clearly shews the great advantage which has accrued from the introduction of the block system, continuous brakes, efficient permanent way and substantial rolling stock.

I recently drew attention to the acceleration to the Scotch Expresses on the Northern lines; not content with what has been done, the Traffic Superintendents of the West Coast and East Coast routes have further increased the speed from the commencement of this month. On the former route, the run between London and Edinburgh has been reduced to 8½ hours. On the East Coast route the 10 o'clock express which leaves Kings Cross is timed to arrive in Edinburgh at 6 P.M., and the first train which consisted of eight coaches heavily laden did the journey in 7 hours 57 minutes. Deducting 5 minute stoppages at Grantham, Newcastle and Berwick and 20 minutes for dinner at York this gives an average speed

of over 53 miles an hour—the finest long distance regular run in the world.

The *Builder*, however, thinks there may come a period in the race between the two Railway Companies when the interference of the Board of Trade would be desirable, as there is a great temptation to overpass the limits of safety in speed if the game of out-bidding one another in speed goes on unchecked.

The Directors of the District Railway having invited 50 of the largest shareholders to confer with them as to the measures to be adopted to improve the present position of the Company, a Committee was thus formed who have just issued their Report which is exceedingly unsatisfactory to the shareholders. By this Report it appears that capital was raised on very high terms for the construction of the Railway, that the City lines are as yet a great mistake—their traffic hitherto being poor, and their construction resulting in an annual loss to the two Companies of £60,000, and thirdly the severe omnibus competition carried on the great east and west thoroughfares which mainly run parallel to the Railway. This loss the Committee state may be estimated at about £40,000. The Committee, however, look forward to a great development of traffic on the suburban systems of the Railway which they believe will be rapid, and they put the prospective improvement in traffic in the next 3 years at about £70,000 which they hope will be much exceeded. The Committee cannot see their way in making any reduction in the working expenses, and they consider an amalgamation or working union with the Metropolitan would not remedy past mistakes, and would neither tend to raise the income or materially reduce working expenses.

An amended Bill for the Sanitary Registration of Buildings has been introduced into Parliament. Its provisions being of a very advantageous nature, it is not likely to meet with the opposition its predecessor had to contend with, but from the support promised this Bill is likely to become law.

Lord Thurlow's Bill of 5 clauses to amend the Electric Lighting Act has passed both Houses. Under the former Act the Local authority could purchase any public electric lighting plant 21 years after the date of the order authorizing its erection for a sum representing its actual value at the time without any compensation for good will or disturbance. Now this time is extended to 42 years, a period which it is presumed will allow of the accumulation of a reserve fund sufficient to reimburse the shareholders for the loss they will experience on the sale of their machinery and plant.

The Town Council of Harwick have had under consideration the question of the public lighting of the Borough. The Committee recommend that the offer of the Defriess Company to light the lamps of the Borough with oil lamps of 30 candle power each for 9 months in the year from sun-set to sun-rise at the price of £1-17-6 per lamp per annum be accepted, including lighting, cleaning, &c., and that the lamps are to be purchased on the 3 years' system.

A large hotel and residential mansions are to be erected on the site of the Royal Aquarium, Westminster, which has recently been sold. Mr. A. H. Kersey is the Architect for the new block of buildings, the main front of which in Tottill will present a very imposing façade. At the Broad Sanctuary end a tower will rise to emphasize the grand hotel which is to face Westminster Abbey. At the other end of the site where the aquarium theatre now stands, a series of flats is to be erected, and in the central portions of the buildings furnished residential chambers are to occupy the upper floors, the lower portion being devoted to spacious offices. The design of the buildings is described as a picturesque rendering of continental Renaissance.

It has been finally decided, after many years consideration, to construct a marine drive to connect the two cliffs at Ramsgate at a cost of £50,000. This desirable work is likely to be proceeded with at once. It will effect an entire transformation of the sea front, including the removal of the harbour office; the construction of a new quay for yachts, and a new and improved approach to the sands and to the London Chatham and Dover Railway.

THE works which have been undertaken at Batoum, for the purpose of converting it into a harbour capable of holding men-of-war, are expected to be finished in January. They consist of a mole, quay, and jetty, all covered by the fortifications.



# MATHESON & GRANT'S HALF-YEARLY ENGINEERING TRADES' REPORT.

LONDON, July 16th, 1888.

THERE has been a decided improvement in trade during the past six months, and though prices are still low, the increased activity in the leading factories and the favorable export returns of the Board of Trade afford unmistakable signs of encouragement for the immediate future. But revivals, when they occur, seldom take old lines, and those manufacturers and traders who look only to former sources of profit may suffer disappointment, the adaptation of machinery and plant to different though kindred articles or the adoption of new methods frequently affording the best opportunities. Low selling prices are largely met by a corresponding cheapness in materials and stores, but there has been little reduction in wages, and skilled workmen in many branches have already announced an intention to press for higher rates of pay if the present improvement in trade is maintained.

COAL has not varied much in value for metallurgical and engineering purposes, but indications point to an advance. The low prices that have pressed so severely on coal owners have been largely due to the system of dead rents, under which a minimum royalty has to be paid, whatever the quantity mined. To earn this royalty an undue quantity of coal is raised in dull times and forced upon the market, thus bringing down the current prices. In South Wales there has been considerable increase in the export trade and a corresponding advance in price, but it hardly seems likely that the advance will be fully maintained. On the Tyne prices have not varied much since our last Report.

IRON.—There is little change in the prices of pig iron since January; the demand for home consumption is better; but the export trade has not improved. Owing mainly to sales by speculators who no longer cared to hold stocks bought at higher prices, Scotch pig fell continuously from January last, but the tendency is now upwards. In rolled iron, although prices are still very low if judged by the standard of former years and by the present cost of manufacture, the demand is every week improving and buyers are no longer able to dictate prices and terms. Contracts for extended delivery can only be made at an advance on present prices. The low quotations for German iron tell severely in foreign markets and to some extent even in Great Britain, but prices in Germany are non-remunerative, and the strong efforts there to form a combination among makers so as to stop the ruinous competition have not yet succeeded. Much confusion is caused by the substitution by German dealers of mild steel in the place of iron, merchants and users being in many cases unable to understand the essential difference between puddled iron which is fibrous and ingot iron (*fluss eisen*) which is homogeneous and unsuitable for many of the purposes for which rolled iron is required.

STEEL.—The sanguine hopes with which the year commenced have not been realised, the demand from the United States having fallen off and the revival in the ship-building trade not having extended as there seemed reason in January to expect. The renewed activity among Engineers still encourages makers to anticipate an improvement in the autumn, but the enormous capacity of production of large modern steel works in Great Britain, as well also on the Continent and in America will neutralize any moderate increase in the demand that may take place. It is noticeable that apart from the fluctuations in prices that have attended steel as well as iron during the last five years, there has been a steady change in the relation between the two. The actual cost of production, which in the long run must be the basis of price has, in the case of steel, continued to fall, while in iron-making the troublesome intermediate process of puddling hinders reduction below a certain point. This was evidenced some four years ago in regard to rails where steel has entirely superseded iron, but it has, though more slowly, taken effect in other forms of rolled steel also. On the other hand the preference for rolled iron over steel for certain purposes is as firm as ever. Thus while for ships, bridges, and certain kinds of boilers, steel is taking the place of iron, boiler-plates in some cases and rolled bars in others, are likely always to be made of high class iron. In fact the best Yorkshire iron, such as Farnley and Lowmoor, commands a better price to-day than it did a year ago.

The following list shows the fluctuations in values during the last five years:—

	PER TON.						
	July. 1883.	July. 1884.	July. 1885.	July. 1886.	July. 1887.	July. 1888.	July. 1888.
Steam Coal, f.o.b. at Cardiff	£ 12 0	£ 11 6	£ 10 3	£ 8 9	£ 9 3	£ 9 0	£ 10 6
West Hartley Coal, f.o.b. at Newcastle	£ 10 0	£ 9 6	£ 9 0	£ 8 3	£ 8 6	£ 8 0	£ 8 3
Pig Iron at Glasgow, No. 3	2 7 6	2 1 6	2 1 0	1 19 0	2 2 6	2 3 0	2 1 6
Pig Iron at Middlesbrough, No. 3	1 19 6	1 17 0	1 12 0	1 10 0	1 14 6	1 13 6	1 12 0
Iron Ship Plates at Middlesbrough	6 0 0	5 0 0	4 15 0	4 7 6	4 12 6	4 15 0	4 17 6
Iron Bridge Plates in South Yorkshire	7 10 0	6 15 0	6 0 0	5 5 0	5 7 6	6 0 0	6 5 0
Steel Ship and Bridge Plates	9 10 0	7 15 0	7 2 6	6 5 0	6 5 0	7 0 0	7 0 0
Iron Rails, f.o.b.	6 0 0						
Steel Rails, f.o.b.	4 15 0	5 0 0	5 0 0	4 0 0	4 3 0	4 3 0	4 0 0

SCRAP IRON AND STEEL have not been in much demand, and there have been few shipments, Italy being at present the largest customer. About 56s. per ton for old iron rails and 42s. for heavy wrought scrap are the present prices free alongside in London.

COPPER AND TIN.—The prices of these metals do not, as a rule, have more than a slight and incidental effect in most branches of the engineering trades, and they are not generally referred to in these reports. The wide fluctuations in price during the last twelve months

have however been so serious and caused such inconvenience as to demand attention. For Tin there are very few sources of supply in the world; there is practically no means of recovering old or used metal for remelting, and even in the dull times of recent years a fair value was maintained. With Copper the case is entirely different, and while in the ten years ending 1880 the price only ranged from £55 to £107 per ton; the opening out of new mines in America caused a revolution in prices, which fell in 1886 to below £40 per ton. In 1887 syndicates or combinations of capitalists succeeded in raising the price of Tin to £167, and of Copper to £85. Owing to the incomplete action of the Tin Syndicates rather than to any intrinsic inferiority in the relation of supply to demand, as compared with Copper, the artificial stimulus collapsed, and Tin, which in January last stood at £167 per ton, fell suddenly at the beginning of April to about one half that price, namely, to £83, where it now stands. Copper however has still a nominal value of £80, but the enormous stocks that are held in America and elsewhere added to the growing output renders almost certain an early collapse of the copper market also. The stocks of tin are not large, and taking into account the general improvement in trade the price is likely, from natural causes, to be maintained and even to advance.

MECHANICAL ENGINEERS are as a rule busier than last year, and, judging by the proportion of enquiries that result in actual business, the prospects for the autumn are good. The increase in the general exports of the country is favorable to Engineers, as activity in the textile as well as in the iron and other trades tells speedily on all who provide the machinery of manufacture. Plant and tools for iron and steel works, mining and pumping engines, arsenal plant, railway appliances and workshop equipment for home and Indian lines are what at present afford most employment. Petroleum engines, in which vaporized oil serves the same purpose as gas in a gas engine, are apparently a success. There is the same cycle of explosions and the advantage is only where cheap gas is unprocurable.

BRIDGES AND STRUCTURAL STEEL-WORK are now purchasable at prices unprecedentedly low and it can only be hoped that the encouragement thus afforded to public works by the cheap construction of railway bridges and large roofs may compensate makers by an increased demand for the low prices they have been obliged to accept. The solidity and permanent durability of riveted work which the modern system of hydraulic machinery allows is encouraging the choice of such connections in preference to pin joints, and even in the United States, where the latter method has prevailed, it is becoming recognized that the cheapness and expedition in erection which pin joints allow are not the determining feature in bridges for heavy railway traffic. In America, pneumatic riveting machines in which a low air pressure is concentrated by larger cylinders and longer levers than in English hydraulic machines are almost universal for portable machines. Hydraulic pressing and forging machines are common to both countries, but except in Steel works the accumulator system is not so widely applied in America as in England. Bridges have been in considerable demand for India, South America, and the Colonies, but there are no new structures of importance ordered so far this year. The railway companies in England are steadily strengthening and renewing their older bridges to meet the exigencies of modern traffic, while in Canada and the United States the replacement of old wooden structures by steel or iron will give employment to bridge builders in these countries even though the demand for new lines should not meet present expectations. Of works in progress, the Forth Bridge still commands the attention of engineers, and it seems certain that it will be completed in about two years. The Eiffel Tower now building as part of the Paris Exhibition of 1889, is already erected to a height of 200 feet, and when completed to its intended height of 1,000 feet, will almost rival the Forth Bridge as one of the modern wonders of the world.

SHIP-BUILDING.—At all the leading yards in the country there is an increase of from 20 to 60 per cent. in the tonnage under construction as compared with last year, but this advance on what was really an unprecedentedly idle time does not at all meet the eager anticipation with which the revival last autumn was received. There is still much unemployed tonnage afloat, and it is rather to the low prices and to the desire for quicker boats than to any more serious demand that the present activity is owing. Numerous large ocean steamers are being constructed, as well as war ships of all sizes. Triple-expansion engines are now the rule in new boats, and in older boats engines of a less economical kind are being altered or replaced as an essential condition to further employment.

LOCOMOTIVES AND ROLLING STOCK.—Prices are still very low and hardly more remunerative than a year ago, but the large orders for engines recently given out, mostly to the Scotch firms, for Indian and South American railways may tend to an improvement, for the number of makers is not likely at present to be increased, and there is every prospect of activity during the next six months. The rise in the value of copper and of high-class iron has justified a moderate advance in the price of engines, and as the leading factories become fully employed the extreme competition which has degraded prices during the last few years is likely to cease. Experience with compound engines is slowly accumulating, but such systems are not yet generally adopted. The increase of speed on the best English railways rendered possible by the perfection of the permanent-way, has led to a revival on some lines in favor of single-pair driving-wheels, and the modern invention of the sand-blast which enables such engines to start even heavy trains is likely to encourage the system elsewhere. In the United States the points of difference with English engines are becoming fewer; steel tires are likely to become universal there for all kinds of rolling stock, and wheel centres of cast or forged steel will probably at no distant date supersede the cast iron at present so universally preferred there, but which is proving unsuited for quick running.

AGRICULTURAL ENGINEERS still complain that prices for engines and implements are excessively low; but there seems at last a break in the long-continued dullness in this branch of trade. At home, estates are changing hands, and there is more probability of purchasers



investing capital in improvements, which would include a revived expenditure in agricultural machines. Abroad there are good harvest prospects in the South of Russia and Germany, which take much machinery from this country.

**PORTLAND CEMENT.**—As anticipated in our January Report there has been a marked advance in price during the last six months and it is still maintained. It is probable however that there will be a slight reduction as the winter approaches owing to the usual falling off in the demand for export.

**LEGISLATION** on subjects interesting to the engineering trades does not make much progress. Uniformity in the mileage rates will not be attained by the Railway and Canal Traffic Bill now being promoted in Parliament, nor is such uniformity desirable, even if it were practicable. The Bill for excluding machinery from the rateable value of factories is hardly likely to become law this year, and the Government bill amending the Companies Act so as to ensure the proper valuation and annual depreciation of works sold to limited companies, will probably be withdrawn or postponed. Some amendment is necessary in the face of the increasing number of private firms who are selling their business to Companies at high prices.

The questions of Fair-trade, Free-trade and protection still agitate the minds of manufacturers, and probably, if considered by each as affecting a particular trade, there would be a majority in the country both of masters and men in favor of some modification of the present fiscal system. No change however is likely to occur because any attempt to formulate legislation on the subject would reveal how injurious to manufacturers and in restraint of exports would be any addition to the cost of living or to the purchase of materials. In the Australian Colonies the retrograde policy which leads to the purchase of engineering materials at enhanced prices from local manufacturers and merchants, of what is better made in England, is due not to any theory of political economy, but to the voting power of the artisan class whose jealousy of imported goods is encouraged by a limited number of manufacturers and traders who, rather than the workmen, reap the profit at the expense of property owners and tax-payers. The facility with which money can be borrowed in England facilitates this wasteful system of expenditure. In the United States free-trade principles which, till recently, have only met with a lukewarm support from a minority of the people, are likely soon to receive more attention, the issue being forced in the coming Presidential Election. The inconveniences and losses which must always attend a radical alteration of fiscal policy will, however, hinder any sudden change, and the manufacturers of this country need not anticipate, for some years to come, the serious competition which will arise in foreign markets directly their American rivals are free to sell abroad.

## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

#### Burma, August 18, 1888.

Mr. E. W. Oates, Executive Engineer, 1st grade, Rangoon Division, is granted two years' furlough, with the usual subsidiary leave.

Mr. H. Hoynes Fox, Executive Engineer, 4th grade, sub. *pro tem.*, is transferred from the 3rd Circle to the 1st Circle to take over charge of the Rangoon Division as a temporary measure, *vice* Mr. E. W. Oates, proceeding on furlough, or until further orders.

#### Burma State Railway.

Mr. E. F. Gordon, Executive Engineer, 4th grade, sub. *pro tem.*, is transferred from the Toungoo-Mandalay Extension to the Open line, Burma State Railway.

Mr. G. Nixon, Assistant Engineer, 1st grade, made over, and Mr. E. F. Gordon, Executive Engineer, 4th grade, received, charge of the Pymmana District of the Burma State Railway on the afternoon of the 11th August 1888.

#### Madras, August 21, 1888.

Mr. W. C. Lewis, Assistant Engineer, 1st grade, passed on the 19th July 1888, the Departmental Standard Examination in Telugu.

The following promotion and reversions are ordered:—

Mr. W. C. Lewis, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 1st August 1888.

Mr. A. A. G. Malet, from Executive Engineer, 4th grade, sub. *pro tem.*, to revert to Executive Engineer, 4th grade, temporary rank, with effect from 1st August 1888.

Mr. J. H. Medlicott, from Executive Engineer, 4th grade, temporary rank, to revert to Assistant Engineer, 1st grade, permanent rank, with effect from 1st August 1888.

The following intimation, received from the Secretary of State, is published:—

Mr. J. F. Somers-Eve, Assistant Engineer, 1st grade, Madras, has an extension of extraordinary leave without pay to 23rd October 1888.

Lieutenant-Colonel A. C. Smith, R.E., Executive Engineer, 1st grade, Madras, has been permitted to return to duty.

In accordance with the Resolution of the Government of India, M. W., dated 18th May 1883, Lieutenant W. M. Ellis, R.E., and Lieutenant F. Baylay, R.E., are brought on the strength of the Madras Public Works Department as Assistant Engineers, 2nd grade, Supernumerary, with effect from the dates on which they took up their appointments of Sub-Marine Mining Officers.

Lieutenant Ellis will join the Department in the rank of Assistant Engineer, 1st grade.

#### Bombay, August 23, 1888.

##### Railway.

Mr. J. C. Lyle, Assistant Engineer, 2nd grade, Bellary-Kistna State Railway, passed creditably on the 21st July 1888 the tests prescribed by paras. 9, 10, 11 and 13 of Chapter II., Volume I. of the Public Works Department Code.

#### Punjab, August 23, 1888.

##### Irrigation Branch.

Mr. H. J. Johnston, temporary Executive Engineer, 4th grade, attached to the Lower Sutlej and Chenab Division, is allowed furlough for one year, from the 10th October 1888, or such subsequent date as he may avail himself of the same.

Rai Bahadur Ram Dyak, Executive Engineer, 4th Grade, took over Executive charge of the Upper Sutlej Division, Inundation Canals, from Mr. H. F. Smallman, Executive Engineer, on the afternoon of the 27th July 1888; and the latter officer proceeded on the three months' privilege leave, granted him in Irrigation Branch Memo., dated 27th June 1888, on the afternoon of the same date.

#### Central Provinces, August 25, 1888.

Mr. R. J. B. Thomson, Executive Engineer, returned from the privilege leave granted him in Central Provinces Notification of 4th June 1888, on the afternoon of the 15th current, and resumed charge of the Jubbulpore Division from Mr. C. O. Leefe, Executive Engineer.

#### N.-W. P. and Oudh, August 25, 1888.

##### Irrigation Branch.

Mr. C. H. Hutton, Assistant Engineer, 1st grade, Mainpuri Division, Lower Ganges Canal, passed the Lower Standard Examination in Hindustani on the 3rd January 1887.

##### Buildings and Roads Branch.

Babu Badri Das, Supervisor, 2nd grade, Aligarh District, is posted to the charge of the Bulandshahr District, as a temporary measure.

Mr. H. Clifton, Honorary Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India three months' furlough on sick certificate, in extension of that notified in G. O. dated 27th March 1888.

#### India, August 25, 1888.

Mr. H. J. Oddie, Executive Engineer, 3rd grade, sub. *pro tem.*, and officiating Deputy Consulting Engineer for Railways, Bombay, is, as a temporary arrangement, posted to the Office of the Consulting Engineer to the Government of India for Railways, Central Division.

With the concurrence of the Secretary of State for India, His Excellency the Governor-General in Council is pleased (in continuation of Public Works Department Notification dated 17th May 1888) to admit the undermentioned Engineers with European training appointed to the Public Works Department in India to the benefits of the more favorable pension rules for Civil Engineers, published in Resolution of the Government of India in the Department of Finance and Commerce, dated 18th April 1884:

Mr. R. D. Bayley.

„ P. B. Roberts.

#### Bengal, August 29, 1888.

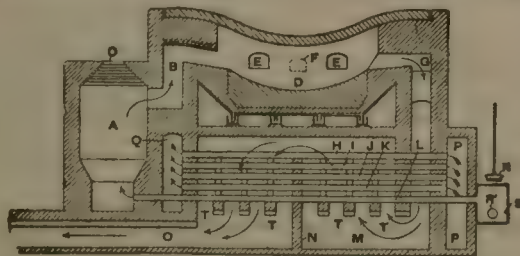
##### Railway Establishment.

Major T. B. B. Savi, R.E., Executive Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India an extension of two years' special leave, in continuation of the furlough granted to him in Government of India Public Works Department, Notification dated 18th February 1887.

## Indian Engineering Patent Register.

### RECENT BRITISH PATENTS.

**OPEN HEARTH FURNACES.**—*H. Burrows, Plumstead, Kent.*—According to this invention the gas producing chamber A communicates with the melting chamber D by way of the opening B. The products of combustion pass out through the opening C, and while in their hottest state pass between the series of regenerating tubes H I J K L; the hot gases afterwards enter the chamber M, which is provided with a

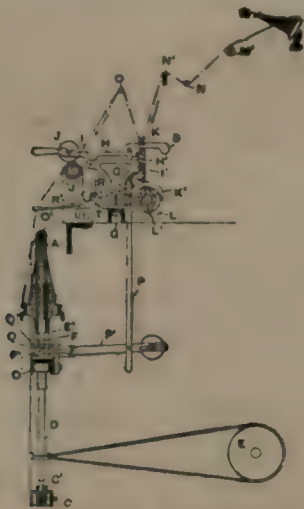


partition N for the purpose of thoroughly diffusing the gases among the tubes. The air is admitted through a valve into the chamber P,



from whence it passes through the tubes and becomes heated. When it arrives in A it is mixed with gas which is supplied through the valve R and tube L. A tube R<sup>1</sup> is provided in case a forced draught is required. The inventor claims the regenerating air chambers arranged under the melting chamber so as to allow the heated air to pass through, in combination with the means for diffusing the heated gases among the regenerating tubes.—No. 8207. June 7th, 1887.

DOUBLING AND TWISTING YARNS.—*E. Sykes & D. Sykes, Huddersfield.*—This invention consists of a self-acting mechanism for stopping the delivery of yarn when any of the threads break; the feed rollers and bobbin are caused to cease rotating, while the motion of the spindle, driving band, and tin cylinder is not interfered with. The figure shows a section of the improved machine when the threads are intact. The spindle D is driven from the tin cylinder E, and the bobbin A may be stopped while the spindle rotates by raising the cone F on the bobbin out of contact with the cone F<sup>1</sup> on the spindle. The bracket G<sup>1</sup> supports the rocking frames H H<sup>1</sup>, which are pivoted at I and I<sup>1</sup> respectively; the drop wire frame H<sup>1</sup> is provided with notches, which fit into corresponding notches in H. The roller K<sup>1</sup>



is driven from the main shaft, and carries two projecting rods L<sup>1</sup>. The two feed rollers are shown at J J<sup>1</sup>. When the thread breaks, the eyelet K on the frame H<sup>1</sup> descends, and its lower end comes in contact with the rods L<sup>1</sup>; the frame H<sup>1</sup> is thus oscillated, and its upper end with the notches in it moves to the right and allows the right hand end of H to descend. The feed rollers are thus separated, and the delivery of thread is arrested; at the same time the rod P moves downwards and causes the cone F to be raised, with the result that the bobbin ceases rotating. An additional apparatus is added in case the thread breaks between the feed rollers and the bobbin. The eyelet O<sup>1</sup> is placed at one end of a lever R, which is pivoted at R<sup>1</sup>; the lever carries a rod at the other end which passes through an eyelet in a sliding vertical rod in the frame H<sup>1</sup>. When the thread breaks, the eyelet O<sup>1</sup> ascends and the other end of the lever descends, and the same train of mechanism is put in action as before. Three claims are made for the frames H H<sup>1</sup> and balanced lever R.—No. 8325. June 10th, 1887.

ADVERTISEMENTS.

WANTED

A SUB-ENGINEER capable of taking independent charge of a Sub-Division; none but men of long experience, and such as have actually held charge of Sub-Divisions, need apply to—

J. C. SIRKAR, C.E.,  
Executive Engineer, Cashmere State,  
Srinagar.

WANTED

AN Estimator for the Office of the Executive Engineer, Tirhut State Railway, Mozufferpore. Salary according to qualifications. None need apply who has not a thorough knowledge of estimating and taking out quantities from drawings.

(182)

J. M. MONTAGUE,  
Executive Engineer.

NOW READY.

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FOR ENGINEERS AND ESTIMATORS.

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P. W. D.

CHITTAGONG DIVISION.

Tenders are invited for manufacturing and delivering the materials noted below. The Executive Engineer does not bind himself to accept the lowest or any tender.

NAME OF WORK.	Tender to be in Form No.	Amount of earnest money to accompany each tender.	Date and hour of opening tenders.	Date of commencement of delivery.	Date of completion of delivery.	Deposit money required to be paid by the successful tenderer.	REMARKS.
Manufacturing and delivering at Chittagong for the Revenue and Judicial Courts and Offices at Fairy Hill. 30 Lacs of Table moulded and Pugged bricks to be delivered at the foot of Fairy Hill on Sites selected by the Executive Engineer.	P. W. D. Form No. 14 Supply of (materials).	Vide table of rates on the form quoted above.	5th September 1888. Wednesday (12 noon.)	Half before the 31st March 1889.	1st September 1889.	Ten per cent. on the total value of the supply.	Particulars and specification can be seen— At the office of the Executive Engineer, 1st Calcutta Division. At the office of the Executive Engineer, Dacca Division. At the head office of the Chittagong Division (Chittagong.) Samples of materials required can be seen at Chittagong.

F. SILLS, C.E.,  
EXECUTIVE ENGINEER,  
Chittagong Division.

CHITTAGONG;  
The 3rd August 1888

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**Notice.**

TO CONTRACTORS AND OTHERS.

**For sale at the S. M. Railway Company Stores at Hubli.**

10 Portable Engines, 10 H.-P.  
 2 Portable Engines, 12 H.-P.  
 Also the following Centrifugal and Contractors' Pumps :—  
 5 eight-inch Centrifugal Pumps, "invincible."  
 4 seven-inch Centrifugal Pumps, "invincible."  
 16 six-inch Centrifugal Pumps, "Invincible."  
 4 four-inch Contractors' Pumps.  
 7 six inch Contractors' Pumps.  
 1 six-and-a-half-inch Contractors' Pump.  
 1 eight-and-a-quarter-inch Contractors' Pump.  
 1 two-and-a-half-inch Contractors' Pump.

The Portable Engines and Pumps have all been in use, but they will be put into working order before being sent away.

The Agent and Chief Engineer, S. M. Railway, Dharwar, is prepared to receive offers for any of the above.

They are open to Inspection to any one wanting them.

Apply to AGENT and CHIEF ENGINEER.

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S. M. Railway-Dharwar.

**JEYES' SANITARY COMPOUNDS**

Thirty-one Prize Medals and First-class Certificates  
 Gold Medal, International Exhibition, London, 1885.

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Not a single case of illness occurred amongst the Native  
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 in Churches, Hospitals and Public buildings  
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Price (reduced)  
 If 20 or more are taken  
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These wheels are Noiseless and self-lubricating, do not drop oil or allow the  
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 Vertical or Horizontal wheels, and run perfectly for years without attention.

(134)

Sole Agents for Madras :—

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**TIRHOOT STATE RAILWAY.****NOTICE.**

**T**ENDERS are invited for loading and unloading wagons  
 at the Ganges Ferry of this Railway. Forms of tender  
 may be obtained on application to this office after the 10th  
 instant. Tenders should be addressed to Manager, and be in  
 his office not later than noon on the 1st September 1888.  
 Tenders must be sent in on the required form, or they will  
 not be considered, and the cover of same should be super-  
 scribed "Tender for Ferry Contract." The Manager does  
 not bind himself to accept the lowest or any tender, or to  
 give reasons for the rejection of a tender.

H. G. KUNHARDT, CAPT., R.E.,

Manager, T. S. R.

MOZUFFERPORE ; }  
 The 10th August 1888. }

(177)

**CREAT WESTERN HOTEL,  
BOMBAY.**

[29]

MACHINERY  
CYLINDER  
ENGINEOIL SPINDLE  
BATCHING  
LUBRICATING

Stocks of all descriptions always in hand. Contracts at reduced rates,

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(103)

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The Mirzapur Stone and Trading Co., Cut-Stone Contractors and Quarrymen  
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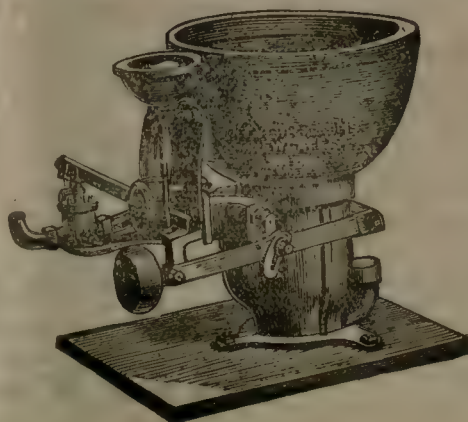
And all descriptions of Cut-Stone. The cheapest in the market.  
 Apply to the Company or to

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(138)

Depôt—Sulkea, Calcutta.

**Calcutta Plumbing & Gas Fitting Establishment.**

Materials of all  
 sorts for the  
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 supplied on  
 the usual  
 terms.

J. D. JONES,

Mechanical Engineer,  
PROPRIETOR.

(108)



## BURRAKUR IRON WORKS, BURRAKUR, BENGAL.

Cast-iron Socket Pipes, of ordinary dimensions, coated with Dr. Angus Smith's solution, and tested up to a pressure of 250 feet of water	Rs. 4-4 per cwt.
Cast-iron Flange Pipes, of ordinary dimensions, tested up to a pressure of 250 feet of water, with faced joints and drilled bolt holes, coated with Dr. Angus Smith's solution	" 5-12 "
Cast-iron Bends, Tees and Cross Pieces for Pipings of ordinary dimensions coated with Dr. Angus Smith's solution from	" 7-0 " upwards.
Cast-iron Fire-bars, Floor-plates, Plain Columns, &c., from	" 5-0 " "
Cast-iron Railway Chairs and Railway Sleepers from	" 3-8 "
Cast-iron Ornamental Columns, railings, gates, spiral staircases, porticos, brackets, arch-fillings, &c., in great variety	At cheapest rates.
Cast-iron Rammers, Road Rollers Garden Rollers, Sugarcane Rollers, Rain-water Pipes, Axle-boxes, parts of machinery and other castings of any description	At cheapest rates.
Water-lifts ... from Rs. 35-0 each, and upwards.	Foundry Pig Iron No. 1 ... " 45-0 per ton.
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	Ditto No. 3 ... " 40-0 "

Remarks.—Special quotations for large orders. Designs of Ornamental Castings of any description can be had on application. Orders to be addressed to the SUPERINTENDENT from whom any further particulars can be ascertained.

(181)

## THE INDIA RUBBER, GUTTA PERCHA, & TELEGRAPH WORKS Co., Ltd., GOVERNMENT AND RAILWAY CONTRACTORS,

MANUFACTURERS OF

## VULCANIZED INDIA RUBBER

VALVES, SHEET, BUFFERS, SPRINGS, WASHERS, WHEEL TYRES, CORD, TUBING &amp; DOOR &amp; CARRIAGE MATS.

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**DIVING DRESSES,**

WATERPROOF GARMENTS AND FABRICS.

Air and Water Beds, Cushions, and Pillows.

The whole of the above-mentioned Stores can be supplied from the Company's Godowns in Calcutta.

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GODOWNS:—DACRE'S LANE.

(168)

*Telegraphic Address—"SILVERGRAY," CALCUTTA.*

## COMMERCIAL UNION ASSURANCE CO., LD.

*Extracts from the Twenty-sixth Annual Report viz. for the year 1887.***FIRE DEPARTMENT.**

Premiums after deducting	
Re-insurances ...	£769,265 0 0
Interest ...	£ 19,612 0 0
Losses after deducting Re-insurances ...	£443,587 0 0

**LIFE DEPARTMENT.**

Premiums after deducting	
Re-insurances ...	£125,559 0 0
Interest and Dividends ...	£ 45,649 0 0
Claims less Re-insurances, ...	£ 79,229 0 0

**MARINE DEPARTMENT.**

Premiums after deducting	
Re-insurances ...	£175,118 0 0
Interest ...	£ 8,294 0 0
Losses after deducting Re-insurances ...	£138,365 0 0
Interest not belonging to above, but included in Profit and Loss	£ 18,545 0 0

**The Life Fund was increased during the year by £65,648 and now amounts to £1,070,064.**

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the uncalled Capital of £2,250,000.

The rates of Premium are moderate, but they are not unsafely low, and will be found to stand the test of time, thereby in conjunction with the ample Funds affording absolute security to the assured.

The Total Funds and property in hand on 31st December 1887 stood at £2,613,059.

(39)

**C. H. OGBOURNE, Manager and Underwriter.**

## PURE HYDRAULIC LIME.

**FREE FROM ADULTERATION.**

Numerous favourable certificates of the quality of our manufacture have been received, and the following are fair selections:—

**J. H. APJOHN, Esq.,** Superintending Engineer, Kidderpore Dock Works, says:—

"Mr. McKennie's test for purity applied at Raneegunge shewed that it contained only 22 per cent. of insoluble matter, or only 3rds of the impurity allowed; there can be no question but that it is of very superior quality."

**PAUL DEJOUX, Esq.,** Executive Engineer, Government Cement Experiment Division, reported:—

"It is the best Ghooting Lime imported into Calcutta."

**JAMES KIMBER, Esq., M.I.O.E.,** Engineer to the Corporation of Calcutta, says:—

"It has been for long past and is now invariably used in all works, particularly drainage works. I have much pleasure in certifying to the excellent and reliable quality of the Lime."

**O. A. MILLS, Esq.,** Executive Engineer, P. W. D., 2nd Calcutta Division, says:—

The Ghooting Lime manufactured by Messrs. Burn & Co. is better than any that can be purchased in Calcutta. I have used it in the construction of many public buildings and have been thoroughly satisfied with it."

**N.B.—Our Lime was used throughout all the River Works of the Calcutta Port Commissioners.**

## BURN & CO.,

(179)

**7, Hastings Street, or Raneegunge.**



## Notices.

The Office of Publication of Indian Engineering is at the "STAR PRESS," 19, Lall Bazar, Calcutta.

General correspondence, and all communications bearing upon literary matters, should, as heretofore, be addressed to PAT. DOYLE, C.E., Spence's Hotel, Calcutta.

It is particularly requested that all letters on business concerning subscriptions and advertisements be addressed to the "Managing Agents," MESSRS. BALMER, LAWRIE & Co., 103, Olive Street, Calcutta; and all remittances be made payable to them.

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Including Postage in India	Rs. 12	Rs. 7	Rs. 4
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One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
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Double these rates for outside front.

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### NOW READY.

## "Artesian Borings in the Sunderbunds."

As the issues of the journal containing the articles headed as above are out of print, and sufficient inducement having offered, the matter has been reproduced in pamphlet form to meet the requirements of District Officers and others in Bengal and elsewhere.

Price Rs. 2 per copy.—Cash.

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# INDIAN ENGINEERING.

SATURDAY, SEPTEMBER 8, 1888.

## THE VACUUM AUTOMATIC BRAKE.

SINCE the birth of Railways and gradual increase in the speeds of the various trains rendered necessary by the demands of progressive trade and accession in the ranks of the travelling public, there has been a solicitous desire on the part of owners and administrators of Railways to minimise the risks inseparably connected with rapid travelling. To this end there has been a harmonious co-operation on the part of the inventive mechanic, the Engineers and others concerned; and the various evolutionary phases which the controlling power—the brake—has passed through are worthy of attention and study. From the simple hand lever brake, applied to the fore and aft of a train, to the most complicated Westinghouse applied continuously to the whole, is metamorphoses which would prove an interesting subject to the student of comparative mechanics. It is well known how the present rude appliance—the screw brake—on Indian Railways (perhaps with one small exception) invariably proves inadequate in cases of emergency and imminent danger. The break-away train has been found uncontrollable by the present method, and in emergent cases the power available has proved too small to overcome the momentum of a running train—hence the many accidents which have wrecked trains and caused serious loss to life and property. To reduce this, as much as to raise the confidence of the public in the comparative safety of Railway travelling, attention has been riveted of late years to the improvement of the rough primitive brake,—the perfection of which is now presented to us in the "Vacuum," which is destined to supersede all other in process of time. The simple lever brake, the screw brake, the compressed air brake, the chain brake, and the hydraulic brake have each been in its turn tried and found wanting. The supporters of each system naturally considered the superiority of their system unquestionable, and in course of time the battle of the 'brake' ended in the crystallisation of the fact that no other brake could claim a higher place in the estimation of the public and in mechanical art than the 'Vacuum,' which is now largely introduced in England, Ireland, France and other Continental countries, in Australia and elsewhere. After many years of trials on the leading English lines of the various systems, the palm has been given to that of the Vacuum Automatic Brake Company. Wherever the Vacuum brake has been introduced, the result has been most satisfactory, and its superiority to others recognised. In Australia it has had a trial side by side with the Westinghouse, leading to the adoption generally of the former. Here in India for the first time the passenger trains on the Ghat section of the Bolan Railway—constituting the only instance referred to by us—are fitted with the Continuous Automatic Brakes, which have been found to be preferable to the



scientific Westinghouse pressure brake which had been first tried. The disadvantage of this latter brake for working long inclines lies in the fact that it *cannot be applied gradually* so as to enable the driver to have complete control of his train, and *increase or lessen* the speed according to his pleasure. Its action is too sudden, and it has the effect of bringing the train to an absolute stop. On the other hand, the Vacuum brake admits of the *application of any degree of pressure*; its mechanism is *more simple* and *less liable to get out of order* than that of the pressure brake, and the Vacuum tends to *keep the joints tight*, while the tendency of the pressure is to make them leak or burst.

We therefore find that unprejudiced opinion here and elsewhere tends to shew that for simplicity of construction, rapid or gradual action, efficiency, reliability and low cost of maintenance, no other known continuous brake applied to the whole length of a train, easily operated or controlled, can, without contradiction, claim a higher merit than that we are writing about, viz., the "Vacuum Automatic Brake"—a brief notice of which will, we trust, prove interesting to our readers. The assemblage of parts which constitute the brake consist of the brake blocks proper, levers, pistons and cylinders, and an ejector. This brake stops the train by the application of brake blocks to the tyres in the same manner as the ordinary hand brake. The levers which operate the blocks are moved by a piston working in a cylinder, which piston derives its power from the *pressure of the atmosphere*. The application being continuous, each vehicle carries *its own brake cylinder*, all of which cylinders are connected to one pipe running from end to end of the train, and it is through this pipe that the action of the brake cylinders is controlled. An ejector placed upon the engine exhausts the air of the continuous pipe and cylinder. The brake is applied by the admission of air into the train pipe, and released by the withdrawal of the same through the ejector. The brake can be applied by the guard, and is self-acting in the case of an accidental parting of the train, or any damage happening to the brake itself. It is instantaneous in its action, and can be regulated to a nicety for easy slips, or to control the train on an incline. The advantages claimed for it are *less atmospheric air required*; it is *direct acting*; instantaneous in its action; can be applied to any number of carriages; it can be applied any number of times in rapid succession without diminishing its power, unlike the compressed air brake, which loses its power completely after a few successive applications; simplicity in the valve arrangement, the pressure on the blocks ranging from the variable to the full power for instantaneous action; joints are efficiently tight from the fact of the pressure in all cases being external; there is no tendency to burst the connecting hose, as is the case with the *compressed air brake*; economy in the use of steam; no frictional surfaces; no lubrication required; working not affected by dust or frost; no dangerous cocks; it is automatic or self-applying; it can be applied slowly to prevent skidding or "jerky" and unpleasant stopping; and

when running with pilot engine no special instructions are required, and both drivers can use the brake, unlike in the case of the compressed air brake, in which such instructions are necessary.

From the foregoing it will appear that this is virtually "Nature's Brake," and there is complete compliance with the Board of Trade requirements. As to its performance, we find that the Returns from the Board of Trade, speak volumes in favor of the Vacuum automatic brake, and we are surprised that, with the exception of the instance alluded to by us, no other Railway Company or management in India has thought it proper or more economical in the working and prevention of accidents to introduce and adopt this brake. The East Indian Railway should, we think, be the first to move in this direction, as the exigencies of the times make it imperative that life and property should be protected from preventable accidents with scrupulous care and solicitude, and the running of the 1,000-ton trains indicates conditions which contribute largely to the increase rather than decrease of accidents. We think that the Government of India should take this matter of continuous brakes into serious consideration, and following up the good example set at home and abroad, should insist upon all Railways adopting the brake.

#### CALCUTTA PORT COMMISSION.

THE Administration Report of the Commissioners for Making Improvements in the Port of Calcutta for 1887-88 is a lucid, carefully compiled, document which leaves scarcely anything to be desired on the score of completeness. The reader is not embarrassed with mere dry statistics, and sufficient explanation is given in the letter-press to make them comprehensible even to the uninitiated in these matters. Of course, the largest works executed during the year were in connection with the Kidderpore Docks, and considerable progress has been made commensurate with the expenditure. The total amount expended up to 31st March 1888 was Rs. 84,58,536, or 37 per cent. of the total estimated cost, which amounts to Rs. 2,27,59,660, and to the end of June last it was Rs. 97,19,127, of which Rs. 73,57,199 were for works, and Rs. 23,61,928 for land. The per centages of the whole quantity of the two leading items of work done are earth work 31·7 per cent. and brick work 30·3 per cent. The works already executed are chiefly in foundation, and the most expensive; therefore the general agreement between work done, and expenditure incurred, may be considered satisfactory. Of course in a limited area, where a large number of native laborers are located sanitation should be the principal concern of the authorities, and we are glad to note that it was looked after in an efficient manner. In 1886-87 the number of deaths from cholera was 62, the average number of coolies employed was 4,350, or at the rate of 14·2 per mille; but in the year under review there were only 59 deaths amongst an average daily attendance of 7,327 or 8 per mille, or slightly over half the rate of mortality which obtained in the previous year.



The expenditure on new works in progress other than the Dock-works amounted during the year to Rs. 6,03,257. Upon the new Tea Warehouse the sum of Rs. 2,06,662 was expended, and that at the Petroleum Wharf Rs. 46,701, for the better protection of the oil cargoes stored there. This was done on the complaint of the merchants that the sheds were not enclosed in any way, and their goods were exposed to the mercy of the weather.

In the expenditure on new works on the Inland Vessels Wharves, Rs. 50,365 was made over to Government for the Chandpal Ghât site, and Rs. 20,427 was spent upon the Moribund House at Kassy Mitter's Ghât. The only other work of importance included in the list of new works in progress during 1887-88 was the construction of a new Light Vessel which cost Rs. 2,37,121. The total cost of the ship, fitted by Messrs. Chance Brothers, with a new lantern, and all the latest improvements had been down to March 1888, Rs. 2,59,134, as compared with Rs. 273,000, the estimated amount, and Rs. 2,74,934, the cost of the last Light Ship constructed for the Commissioners.

The total earnings under the head of 'Jetties' exceeded those of the previous year by Rs. 1,33,585. The discharge and loading of vessels at the Jetties contributed Rs. 32,314 of that sum; the receipts both from imports and exports having been in excess of the previous year. During 1887-88 the number of vessels which arrived at the Budge Budge wharf was 40, and the number of 10-gallon cases of oil brought by these vessels was 2,474,240. The shed accommodation brought a considerable additional income in the rent returns. The total income from the wharf amounted to Rs. 1,16,529, as compared with Rs. 49,823, the income of the eight months from August 1886 to March 1887. The following figures will shew how the oil trade has increased during the last few years; from 1878-79 to 1885-86 the number of 10-gallon cases brought to Calcutta annually averaged 737,337; in 1885-86 the number was 1,070,943; in 1886-87 it was 1,614,300, and last year, as shewn above, it was 2,474,240.

The new Tea Warehouse is another successful venture of the Port Commissioners, and the wonder is it was not thought of earlier. It would have been still more successful but for the obstinacy of the Tea Traders' Association, who wished the Port Commissioners to give a guarantee that the charge advertised for the use of the Warehouse should not be increased. The Port Commissioners, while declining to comply with the request, directed attention to the fact that it was their policy to reduce, and in no case to increase the charges; especially if all the teas passing through the port were warehoused in the new premises, the rates in the schedule would be more than sufficient to cover all charges, and might possibly admit of a reduction. The Warehouse was available for traffic from August 1887, and from that date until the end of March 1888 the number of chests warehoused was 185,543, or about one-fifth of the season's crops, although three months of the season had passed before the tea could be accommodated. The total income derived from the Warehouse during the eight months was Rs. 32,646,

and the working expenses to Rs. 12,793, leaving Rs. 19,853 available towards meeting interest and sinking fund on the capital invested. In the same way there are shewn increases in all departments, and we will conclude by observing that from the statement of the ordinary income and expenditure it appears that the increase in income over that of the previous year is Rs. 2,85,139, while the increase in expenditure is Rs. 2,22,587; this, however, is due to the fact that during 1887-88 Rs. 1,20,000 have been taken from surplus revenue for credit of Port Approaches Depreciation Fund Account so as to pay for the new Light Vessel mentioned above.

### THE CACHAR-CHITTAGONG RAILWAY.

SINCE everybody wants a Railway through Cachar and Assam to Chittagong, its undertaking, sooner or later, is a surety, a hope a little deferred. Chambers of Commerce and Trades' Associations, English and Indian, are in favor of it. Mr. Lyall, Commissioner of the Chittagong Division, is, the Dacca paper says, "strongly impressed with the importance to Chittagong" of having the line constructed. Sir Steuart Bayley thinks there can be no doubt that such a Railway would facilitate trade, and greatly augment Chittagong's wealth. The irrepressible "draw back" hindering progress in this instance is want of capital. We venture to hope that the preponderance of opinion arrayed against this shortcoming will soon lead to its dislodgment. Probably—naturally enough—Lord Dufferin does not care to incur the responsibility of borrowing money for the purpose, just at the close of his Viceroyalty, and when the rupee is not worth much more than a shilling. But his successor will be hampered by no such doubts or scruples. He is understood to be anxious in every way possible to develop the industries and resources of the country he is coming to govern; his Canadian experience has given him practical, judicious insight into the values and uses of Railways; and he has proved himself too sensible a man to be either misled or frightened by false definitions of economy. No man knows better that a paying Railway through an undeveloped and resourceful line of country is one of the best economies possible to a Government struggling with financial pressure; that pledging the public credit with view to construction of such a line is a measure that commends itself to business instincts as well as gubernatorial duty. And there is fair room for supposition that the money required could be raised without much difficulty, and at a cheap rate, in London, where just now money is plentiful, and much of it lying idle. Borrowing for a Railway might possibly entail a howl from one or two Native papers that make a living out of the invention of grievances. It would by no means follow though as a necessary consequence that Native opinion was opposed to the loan. We do not think it would be. Contrariwise, rather, we believe that the money could easily be raised in India—nay then, in the provinces to be opened out by the line



## Notes and Comments.

**THE DELHI-KOTRI SURVEY.**—Mr. Horace Bell, late Manager of the Tirhoot State Railway, now at home, has arranged to sacrifice a portion of his leave in order to conduct the projected Delhi-Kotri survey.

**NEW PUBLIC OFFICES, CHITTAGONG.**—We learn that Mr. W. Phillips, Sub-Engineer in the P. W. D., whose services have been at the disposal of the Kashmir State for the last three years, is likely to go as Sub-Divisional Officer in charge of this important building.

**HINDU HOSTEL, CALCUTTA.**—We are informed that this institution is to be opened for the benefit of students after the October vacation—at what fees we are not told. The question of the addition of an upper story is deferred until the demand for such accommodation justifies the expenditure of more money.

**PROTECTION AGAINST MALARIA.**—The date tree is establishing for itself a valuable sanitary reputation. It feeds off malaria, its modern disciples say, and they cite Bussorah in support of this opinion. Date palms there are said to have completely eradicated malarious fever, and its unpleasant sequelæ.

**KHATMANDU WATER-WORKS.**—We learn that after all Mr. Fennimore is likely to go to Nepal in connection with the Khatmandu Water-Works. The difficulty has been tided over, and Mr. Fennimore will receive suitable remuneration from the Nepalese Durbar while he will be engaged on this special work.

**MR. RIENZI WALTON.**—Advices by the last mail give favorable reports of the health of Mr. Rienzi Walton, Executive Engineer, Bombay Municipality, who went home at the beginning of the year in a very critical state of health, and had a long subsequent confinement at home from the after effects of the typhoid fever.

**MILITARY WORKS DEPARTMENT.**—It has been decided that officers and subordinates of this Department shall continue, as heretofore, to be subject to civil leave rules as regards privilege leave, and to military leave rules for other kinds of leave. It is said that much inconvenience would be experienced if the privilege leave of the officers is granted under military rules.

**MADRAS DRAINAGE WORKS: ANOTHER LOAN.**—Government have accorded their sanction to the Municipal Commissioners of Madras raising a further Debenture loan of one-and-a-half lakhs in the current official year for the drainage works of Black Town. The loan is to be repaid by an annual sinking fund payment of Rs. 990, accumulating at compound interest at 4 per cent. per annum.

**METEOROLOGICAL INFORMATION.**—Might we suggest the preparation of a small hand-book of meteorological facts and figures—condensed into a small and “get-at-able” form? There are many occasions when such facts and figures are wanted, and they can only be got at by wading through tables upon tables of observations,—an effort which most busy men have neither the time nor the spare energy for.

**INDIAN COTTON MANUFACTURES.**—The *Indian Daily News* says that if local industries are ever to displace, in any material degree, the call from India on foreign nations for manufactured goods, and *pro tanto* augment the requirements for silver, or its representative, in adjustment of the balance of trade, the large

investments of the last few years in cotton mills cannot fail to excite attention.

**OPENING OF THE MELBOURNE EXHIBITION.**—The Centennial International Exhibition, held to commemorate the centenary of British settlement in Australia, and to demonstrate the results of a century's progress in art, manufactures, and industry, was opened on 1st August, by His Excellency the Governor, in the presence of a vast and representative assemblage, and amid many manifestations of popular rejoicing.

**AN IRRIGATION PROJECT.**—Colonel Bowen, R.E., the Chief Engineer of the Mysore P. W. D., is at present making arrangements for the commencement of the Borankimedy dam, across a gorge in the hills of the Tumkur District, for an irrigation reservoir, the execution of which has been sanctioned by the Mysore Government at a cost of over three lakhs of rupees. The dam will be the largest irrigation work in the province.

**PULTAH WATER-WORKS EXTENSION.**—The new engines pumps, settling tanks and filters at Pultah are now at work, and the water at present used by people in Calcutta is supplied from these new works. It is an interesting excursion either by rail or river to visit these works, and both Mr. Price, the Superintendent, and Mr. Collard, the Engineer from Messrs. Fawcett and Preston, are known to give visitors every reason for gratification.

**THE EXTENSION OF THE KANDAHAR RAILWAY.**—The tunnel through the Khojak mountain is progressing fast and will, when ready, be about five miles long. English miners are working in it; and on the Quetta side it may now be safely entered and traversed to a distance of 800 feet. The shaft has been dug out to a depth of 280 feet, and requires to be carried 60 or 70 feet deeper before it will be on a level with the main line of the tunnel.

**GOLDFIELDS OF SIAM.**—With a capital of £250,000 in shares of £1 each, a company is formed for the purpose of acquiring concessions for working the goldfields of Bang-taphan, Siam, comprising both alluvial deposits and quartz reef. These goldfields are situated in the Malay Peninsula, between 11 deg. and 12 deg. north latitude north of Singapore, about 170 miles by sea from Bangkok, and 12 miles from the sea coast, where there is a good harbour.

**REDUCTIONS IN THE P. W. D.**—The proposed scheme for the reduction of the establishment of the Public Works Department has yet to go before the Secretary of State. Some little time is therefore likely to elapse before the officers affected by it can be communicated with. The reductions proposed are to be compulsory, and will not take the form of an inducement to retire in the shape of specially favourable terms, which those affected may reject or accept.

**RETURNING FROM BELUCHISTAN.**—We learn that Messrs. Rushton and Starkey, Assistant Engineers, who were temporarily transferred to Beluchistan, are likely to return to Bengal very shortly. Mr. W. H. King, Executive Engineer, and Mr. H. Green, Assistant Engineer, have already come back: of Mr. Hoernle we have made special mention; and Mr. J. D. Davies, Executive Engineer, has been transferred to Madras—a step against which we hear he has appealed.

**A HINDU WELL TO THE FRONT.**—We are glad to hear that Baboo Debendro Nauth Mullick, winner of the Gilchrist scholarship two years ago, has won further educational honors in London, having secured at the London



University a £50 Exhibition of the Clothworkers' Company, a first prize in experimental physics, and elementary mechanics, and a silver medal in chemistry. *Sec itur ad astra.* Baboo Debendro Nauth Mullick promises to be an ornament to the profession of Engineering.

**JOURNALISTIC RECTITUDE.**—We commend the following excerpt from the *Morning Post* to the attention of the *Pioneer*:—"The *Times of India* states that it has been sounded with the view to becoming the official organ of the Government of India, but 'our reply was so clear and distinct a negative as to admit of no misconception.' Does this mean that the Government is wearied of the journal that at present does duty as the administrative broom? It looks extremely like it."

**SIMLA FINE ARTS EXHIBITION.**—The Fine Arts Exhibition was opened on the 1st instant by Sir Charles Elliott in the presence of the Viceroy, Lady Dufferin, the Lieutenant-Governor and Lady Lyall, and a considerable number of the general public. Sir Charles Elliott, in his opening address, said that the water-colours were 203 against 125. They might congratulate themselves on this increase, particularly as last year several professional artists exhibited, whereas there were none on this occasion.

**RAILWAY BRAKES.**—The *Englishman* writes:—"One of the chief questions which will come before the Railway Conference at Simla is the use of brakes on Indian Railways. At present the Railways in this country are not provided with any special system of brakes, such as is in operation on almost every European line. Our Railways depend entirely on hand-power brakes applied on the engines and brake-vans, but by way of practical experiment three systems of more efficient brake-power are shortly to be tried at Umballa."

**CAOUTCHOUC.**—Since the annexation of Upper Burma the trade in this product has greatly increased, the value of exports having been in 1885-86 Rs. 35,052, in 1886-87 Rs. 1,54,824, and in the year under review Rs. 4,56,681, while the quantities have been 359 cwts., 1,216 cwts., and 2,968 cwts. in the three years. The monopoly is now in the hands of a firm of Rangoon and Bhamo Chinamen, who have secured it from Government. This firm is now working systematically and sending down larger supplies than were hitherto available.

**MADRAS HARBOUR WORKS.**—The London *Engineer* says:—"It has recently leaked out that the foundation of *pierre perdue* on which the new breakwaters were founded was composed of laterite, that material being adopted in opposition to the Engineer's views and representations, who desired that granite only should be used. To those who know the nature of laterite, it can now be no surprise that the works came to the almost ruinous grief that they did during the cyclone of 1881." But our articles on the Madras Harbour demonstrated this some fourteen months ago.

**ADVANCE KURRACHEE.**—Mr. Eduljee Dinshaw has it in contemplation to establish a spinning and weaving industry in Kurrachee, upon which he is prepared to embark a capital of ten lakhs of rupees. He calculates that the enterprise will at first afford employment to between 1,200 and 1,500 operatives, and in view of it being a pioneer industry, he has applied to the Municipality for certain concessions, which, the Municipality has received, or is expected to receive, with

favour. There can be little, if any, question that great advantage will accrue to Kurrachee if the project prospers.

**INSPECTORSHIP OF LOCAL WORKS, BHAGALPUR.**—Rumor has it that Mr. O. Hœrnle, Executive Engineer, whose services were lent to the Government of India for special duty in Beluchistan, is likely to be appointed to this post on his return to the province. We have reason to believe, however, that there is some foundation in a later rumor to the effect that he has applied for two years' leave under the special rules lately offered to the P. W. Department. Should this be the case, we may again point to Mr. C. A. Mills's claims, unless Government considers he is too well placed in Chittagong to be transferred yet.

**UNDERGROUND TELEPHONE WIRES.**—A Correspondent writes: I have sent you to-day a copy of the *Melbourne Argus*, containing an account of a trial on a large scale of Mr. James' patent telephone wire conduit. You may remember I sent you a short account of this from Australia last year. The test seems to have been a very good one, and I hope you will be able to make some use of the paper. We are sorry that we have no room for extracts. But we think that the extension of the telephone system in large cities should force the attention of their authorities to the necessity of providing some other means of carrying the wires than upon poles placed along the streets.

**SATISFACTORY PROGRESS.**—The Bengal-Nagpur Railway Staff are pushing on their work with a will. The old metre-gauge line of 150 miles, from Nagpur to Raj Nandgaon, will be opened on the standard gauge during October, and at the same time the extension to Raipur, 40 miles. At the commencement of next year, it is hoped that 65 miles additional, to Bilaspur, will be ready, and perhaps yet another 50 miles at the Bengal end. What the line wants, however, what the Central Provinces particularly want, is feeders. Both material and money are being found for these by the Supreme and Local Governments, and some 60 miles of such feeders, in the Balaghat direction, are now being estimated for.

**BOMBAY WATER-SUPPLY.**—As already announced, the Town Council, at their last meeting (22nd August), decided to refer the whole of the papers on the subject of leakage of Service Reservoirs and proposed remedial measures; improvements and extensions of filters to a Sub-Committee for report. We now hear that the Committee is composed of Sir Henry Morland, Assoc. Inst. C.E., Lieutenant-Colonel Merewether, R.E., Major H. O. Selby, R.E., Surgeon-Major G. Waters. We also learn from another source that the Tulsi Lake of these (Bombay) works began to overflow on the 21st August. At Vehar the rainfall is much less than last year, and the lake is not yet full, requiring about 1,500 million gallons to secure that result.

**RAILROAD GAUGES IN VARIOUS COUNTRIES.**—*Asia*: In British India about two-thirds of the total mileage are laid with the 5ft. 6in. gauge and the balance in five different gauges, varying from 2 to 4ft., the longer mileage being represented by the 3ft. 3½in. gauge. On the Island of Ceylon it is 5ft. 6in. The Russian Trans-Caucasian Railways have adopted the Russian standard, 5ft. On the Island of Java 3ft. 6in. gauge is adopted on about four-fifths, and 4ft. 8½in. on the balance of the total mileage. In Japan the 3ft. 6in. gauge has been adopted on all lines with one single exception. *Aus-*



*tralia*: The gauge varies in the different colonies. It is 4ft. 8½in. New South Wales; 5ft. 3in. in Victoria, and 5ft. 3in. and 3ft. 9in. in South Australia. This last gauge is also found in the other colonies.

**CYCLONES AND CURRENTS.**—Mr. H. F. Blanford, of the Indian Meteorological Department, contributes an article to *Nature* on the "Incurvature of Winds and Currents and the Management of Ships in Cyclones." The subject is an important one, especially for mariners, and the writer points out the error of supposing that the wind in Bay of Bengal cyclones blows round in circles, as if they had no beginning or no ending; and that the centre of them always bore eight points right of the surface wind direction; and to prove the mistake which is still apparently being made by Professor Faye of adhering to this theory, he gives the result of his long experience in the India Meteorological Department and his close investigation of the particulars of no less than two hundred and twelve cyclones of the Bay of Bengal.

**THE RAILWAY POLICY OF GOVERNMENT.**—Somebody asks:—Why does Government not throw open to private enterprise the construction of future Railways in Burma? The Moo Valley Railway scheme, notwithstanding the intended survey to be undertaken in November next, is likely to remain only a scheme to be shelved by Government for many years to come on the ground of impecuniosity, just as the Sittang Valley Railway was for 15 years, though private enterprise offered to undertake it either on a certain guarantee, or the allotment to the concessionaires of alternate sections of land along the line, as is done in some of the Colonies. The dog-in-the-manger policy of Government is retarding the progress and development of the country, while the plan we suggest would help materially to create more revenue for Government.

**THE GOLD-FIELDS OF VICTORIA.**—We learn from the latest report that during the first quarter of the present year the magic word amongst mining men generally, and mining sharebrokers in particular, in the Colony was not gold, but "silver," and so eager was the pursuit of the latter metal—or rather of the paper which represented shares in supposed silver mines, no matter where located—that gold-mining, for the time being, was completely in the background. The silver craze has now somewhat subsided, but its effect has been to divert attention temporarily from legitimate mining in Victoria. The yield of gold for the quarter, as might be expected under these circumstances, is below the yield for the last quarter of 1887, the figures being as follow:—Quarter ended 31st December 1887, 166,411oz. Quarter ended 31st March 1888, 156,817oz.

**THE STRACHEY CIRCLE.**—The *Morning Post* observes:—E. I. Railway interests are carefully guarded by the India Office at home, but the public out here are in favor of a certain amount of healthy competition being introduced. But what can we hope for when the Engineering adviser to the India Office, besides being a member of the Strachey circle, is Consulting Engineer for the E. I. Railway and all the State Railways, besides having a finger in every new Company got up. The determination of the Government of India to work the O. and R. Railway as a State line, whether intentional or not, is playing into the hands of the Strachey circle with a vengeance. For the line comes under their sway if worked as a State Railway, and some

members of it will doubtless be glad to join any new Company the India Office may incubate, to take over the working later on.

**THE FOREIGN TRADE OF THE PUNJAB.**—Falling-off in the trade with Kabul and countries on the North-West Frontier as compared with last year is accounted temporary; attributed to Ghilzai and other trans-border disturbances, rather than to any such permanent factors as restrictions on Indian goods imposed by the Russians in Trans-Oxus territory. But it has happened, now and again, in the 4,000 years or so of the world's history, that coming events have cast significant shadows before them. Reports have recently been received by Government, in which it is asserted that active opposition is offered by Chinese Mandarins in authority in Yarkund to the import of Indian tea into that province. Information as to that matter is promised, when available. Meanwhile, perhaps, the more liberal-minded amongst us will be no more inclined to throw stones at the Heathen Chinese in this matter than at the largely increasing class of Fair traders (as opposed to Free traders) in England.

**ANOMALIES.**—The *Times of India* writes:—"The G. I. P. Railway have constructed a station which is the pride of this great city. Whether the ryot's money should have been lavished in a booking office mainly built of marble is a question open to argument, and it is a matter of regret that no suitable accommodation has been provided for the fourth-class passenger, who mainly contributes to the support of the Railway. However, the palatial shrine has been built, and the chief wonder is that it should have been built by the G. I. P. Railway, whose besetting sin is not extravagance but parsimony. Having launched forth into this expenditure of building a magnificent central station, the G. I. P. Railway may, in course of time, spend a few rupees in buying dusters to clean the waiting rooms on the line. They may also, in course of time, take steps to improve the furniture in their refreshment rooms. At present neither the waiting rooms nor the refreshment rooms are a credit to the Company."

**LOCAL FUND ENGINEERS IN MADRAS.**—A correspondent to a contemporary says that if Government, in the P. W. D. of the Presidency, is so short of officers that it has to borrow the services of officers from the Government of India, it is curious that it should, at the same time, be lending its own officers to Local Fund Boards. The Local Fund Engineers of the Nilgiris and Salem, the most popular appointments of the kind in the Presidency, are both on the permanent strength of the D. P. W. establishment, and it is not fair to the many competent men available, and who have inferior or less paid employment, or even no employment at all, to lend the services of Government officers for such work. If D. P. W. Officers find Local Fund service pleasanter and more profitable than their own service—as they surely do, or they would not (and could not be compelled to) accept it—they should resign their appointments in the D. P. W. and not block the way of promotion of other men.

**GOVERNMENT OF MADRAS, LOCAL AND MUNICIPAL DEPARTMENT.**—Read—the following paper:—From J. P. Hewett, Esq., Under-Secretary to the Government of India, Home Department (Municipal), to the Chief Secretary to the Government of Madras, dated Simla, 23rd July 1888, No. 2-122:—"In continuation of Home Department circular, No. 4-140-149, dated the 14th



October 1887, I am directed to invite attention to the article at pages 913-14 of the *INDIAN ENGINEERING*, dated 21st April 1888, giving a further account of the Artesian boring in the Sunderbuns, and the estimated cost of such undertakings." Order—dated 17th August 1888, No. 1528 L. Local and Municipal:—Communicated to all District Boards and Municipal Councils, and to the Municipal Commissioners of Madras, in continuation of G.O., dated 15th November 1887, No. 2179 L. 2. Copies of the journal referred to may be had on application to the Editor, Mr. Pat. Doyle, at Calcutta. The price is one rupee per copy. (True Extract.) J. F. Price, Acting Chief Secretary.

**SANITATION IN CAIRO AND IN AHMEDABAD.**—The sanitary condition of Cairo is very similar to that prevailing in Ahmedabad, the defects of which have recently been pressed upon the attention of the Bombay Government. In the Egyptian City the state of things has become so bad that the place will become uninhabitable if measures be not taken to apply a remedy. A plan has been submitted by two Englishmen, Mr. Cornish and Mr. Wallace, now of Bombay, for removing the sewage by the pneumatic system which has been recently introduced in Paris, and has been tried experimentally in London. The cost of the new system would entail an outlay of nearly half a million sterling, the iron pipes and the pneumatic apparatus running necessarily into a good deal of money. But any system of drainage even approximately effective, is costly, and the absence of all system means epidemic disease and wholesale mortality—perhaps the costlier evil of the two. We hope to give Mr. Wallace's views on this subject generally in an early issue.

**LIFE-SAVING RESOURCES AT SEA.**—Why is it that ship's boats are invariably useless, usually unavailable when the shipwreck comes? In the Annual Report on Emigration from the Port of Calcutta to British and Foreign Colonies for 1887 it is written:—"In consequence of the loss of the emigrant ship *Syria* off Fiji, on the 11th May 1884, and in view of the uselessness of the the ship's boats on the occasion for the saving of life, the question as to whether the vegetable platforms ordinarily fitted to emigrant vessels could not be converted into life-rafts came under consideration in 1885." And seems to have stayed under consideration ever since. Years ago, when railway accidents began to be frequent in England, it was proposed to send a Bishop on the engine of every fast train, by way of insurance against accident. Couldn't we spare our Meteorological Reporter as an accompaniment to emigrant ships? We should at any rate be relieved of his misleading weather prophecies; and in different latitudes and longitudes, with everything at sea, they might have a chance of coming true.

**THE PIONEER AND "OURSELVES."**—We are at a loss to account for the *Pioneer* going out of its way, the other day, to vilify and depreciate the Editor of *INDIAN ENGINEERING*. The assault was utterly uncalled for. To the best of our knowledge and belief we have always been scrupulously polite to the Allahabad paper; have never begrudged it its specially retailed Secretariat information, or made awkward enquiries into the manner of its procurement; never made references that might be unpleasant to Simla picnics and tiffins, and other good things—politic. We have always striven to be at peace with all men, whether Secretariat affiliated or independent. It would

seem that all this charitably virtuous endeavour has been lost, wasted, dissipated—that the good seed sown has in the atmosphere of Allahabad and Simla, resulted in a crop of nettles. 'Tis a pity; a misfortune, which we must pluck up heart of grace to bear with the equanimity due to the occasion. *INDIAN ENGINEERING* will probably survive it. But—if only in the interests of Indian Journalism at large—we must protest that it does seem somewhat of a matter for regret that the *Pi* cannot manage to be truthful as well as caustic in its support of Government.

**THE PAY OF THE STANLEY ENGINEERS.**—Colonel Hill asked the Under-Secretary of State for India whether, having regard to the provisions contained in paragraph 23, page 12, of the memorandum attached to and referred to by the covenant entered into between the Secretary of State for India and the Stanley Engineers with respect to "absentee pay," that ten rupees should equal £1, and to the terms of Section 161, paragraph 2, clause 6, exception 2, of the Civil Leave Code, whereby the rights of such officers whose covenant dated prior to 1871 were distinctly safeguarded, he could state why these officers were not allowed to receive their "absentee pay" at the rate of 10 rupees to the pound, in accordance with the above-quoted regulations.—Sir J. Gorst: The Secretary of State cannot admit the premises on which the question is based. No memorandum was attached to or referred to by the covenants of the Stanley Engineers. The memorandum to which reference is made is probably one furnished to the candidates for the Public Works Department; it does not say that ten rupees shall equal £1. Section 161, paragraph 6, exception 2, of the Civil Leave Code, applies to certain early covenants which stated that the pound should be taken as equivalent to ten rupees, but not to those of the Stanley Engineers.

**LIEUTENANT-COLONEL G. F. E. S. NEILL, M.S.C., (P. W. D., BENGAL).**—We learn that there is some probability of Colonel Neill, the Superintendent of Works, Calcutta, proceeding on special leave and furlough next March preparatory to retirement. We can safely say that if this be true, it is Calcutta's loss, for considering the intricate nature and the delicacy of the work performed by the Superintendent of Works in communication with heads of departments, and representatives of local bodies, &c., it is near the truth to assert that there are very few men who are naturally fitted to perform work required in this capacity. To command the support and confidence of those placed under him; to smooth down all irregularities; to meet the requirements, sanitary and otherwise, of a city like Calcutta; to think one day of improvements in brick-making at Akra, another of the outturn of pig-iron or sleepers at Barrakur, another of the work performed at Seebpore: to be at the same time a useful and straight-headed Municipal Commissioner; to be a referee on important matters of P. W. administration; and to be generally a guiding spirit—not an ostentatious one, but a quiet one—is a record which it may again be asserted very few can shew. Couple all this with a patient and genial nature, and some estimate can be formed of the kind of man Calcutta would lose by the retirement of Colonel Neill.

**HOW MUCH THEY KNOW OF INDIA.**—Our contemporary, the *London Engineer*, discussing the question of "Our Eastern Steamers and Australian Coal," says:—"When formerly discussing the properties of Colonial



coal, we have argued that to the fierce heat of the tropical or semitropical sun is due the friable condition of the coal as yet extracted from Indian and Colonial mines. We recently cited the case of some of the *Darjeeling* pits which have already reached a very considerable depth, and we named, when doing so, that the quality of the coal yielded by these was materially improving, though that improvement was likely to be neutralised if the coal, when raised to the pit brow, had to be stored for any length of time exposed to the fierce heat of the sun. We have not the same data available upon which to determine whether coal-mining in Australia has proceeded so far below the surface as to afford hope that improvement similar to that discovered in India may be looked for in the former Continent. But as we may be sure that the agents of the Peninsular and Oriental Company would have exercised every care to put on board the *Victoria* the finest coal locally produced, the relative failure of that vessel furnishes no slight indication that as yet improvement, if it exists at all, has not there proceeded so far as it appears to have done in the mines of *Northern India*.—The Italics are our own.

**THE CONTROL OF CIVIL PUBLIC WORKS.**—The Bill now before the United States Congress proposing the establishment of a "Civil Bureau" of harbours and waterways is characterized as a personal war between Civilian and Military Engineers. An American contemporary—*Engineering News*—says:—"In the early days of engineering in the United States, West Point was the only engineering school within our boundaries, and it supplied many of the men who designed and constructed our earlier public works, men whose names are honored among Engineers. But as the demand for trained Engineers soon exceeded the limited supply from this Government school, other institutions sprang up that devoted the whole course of study to Engineering, and the profession is now mainly recruited from the graduates of the private schools. The Engineering works of a civil character were early put into the hands of the Military Engineers, because they were then the only men competent to control them. But these works have multiplied to such an extent, and demand so much Engineering service that the Government engineers are now compelled to reinforce their body with assistants from civil life, to the extent in 1885, of 70 Military Engineers to 643 civilian employés of all grades. It has long ago ceased to be a position monopolized by Military Engineers in all responsible places requiring any Engineering experience. The only difference is that as at present organized, the Civilian employé, no matter how good an Engineer, or how valuable his personal and professional services may be to his Government, can never hope to reach the topmost rounds in a particular profession to which he devotes his useful life. This is unfair and discouraging to any ambitious spirit, and is not calculated to secure and retain for the Government the ablest Engineering talent in all branches of the service, as the importance of the expenditure of many millions of public money annually demands. We have the greatest respect for Military Engineers, for they include in their ranks many of the ablest Engineers, in our country. But we do believe, in the interest of Engineering as a profession, that the time warrants a reorganization of our present system of conducting public works." Whether this quotation is applicable to India or not, we must leave our readers to decide.

## Current News.

SIR ANDREW CLARKE will be the Chairman of the new Delhi-Kalka Railway.

THE Soldiers' Industrial Exhibition at Poona was opened on the 4th instant by His Royal Highness the Duke of Connaught.

THE Public Works Department has rejected the scheme for a direct line from Mogul Serai to Barrakur along the Trunk Road.

THE Bengal Government has directed that the annual report on the meteorology of that province should be illustrated with maps in future.

MAJOR R. A. SARGENT, R.E. will probably be appointed Manager of the Oudh and Rohilkhand line when it becomes a State Railway.

THE India Office has been asked by the Imperial Government to sanction certain works for the extension of the Western Jumna Canal towards Sirsa, at a cost of nearly Rs. 42,00,000.

A CONFERENCE was held at Simla last week at which the question of the conservation and protection of the Baluchistan forests was discussed, and a programme of operations made out for future working.

LIEUTENANT-COLONEL CONWAY GORDON the Director-General of Railways, will take six months' furlough shortly, the greater portion of which he will spend in a visit to America. His eyesight is now much better.

It is stated in Bombay that there is no truth in the story that Sir Henry Morland has sent a notice to the G. I. P. Railway Company, claiming one lakh of rupees as damages for the injuries which he sustained by being thrown from his carriage the other day.

THE works on the Lundi Kotal plateau are progressing slowly but satisfactorily, and it is expected they will be finished by the end of January. Lieutenant MacDonald, who is in charge, will also prepare estimates for the projected road through the Mulla-gori country.

THE meetings of the Railway Conference at Simla are to be regarded as private. No resolutions which may be passed will be made public until the English Board of Directors of the Companies represented have had an opportunity of examining them and coming to some conclusion.

THE Government of India has ruled that the allowances known as "Burma and Assam allowances" may be drawn by officers on privilege leave, on the understanding that the grant of such leave will not require the transfer to the Provincial Establishment of an officer from any other province.

THE rules for the admission of visitors to ports, coast batteries, arsenal, and military works of all descriptions are published. Foreigners will be required to produce a special authority from the Military Department, and British officers in plain clothes will not be admitted without a pass.

SIR ALBERT CAPPEL does not intend to return to India at the expiry of his leave, and Colonel Mallock will almost certainly succeed him as Director-General of Telegraphs, a post which he will probably hold only for about two years, as he will then be promoted to the rank of Major-General.

As a first step towards a scheme of technical education in the Punjab, the Local Government has sanctioned a grant of Rs. 10,000 from the provincial revenues for the purpose of providing a building for the accommodation of a school of technical instruction, to be established in connection with the Railway workshops at Lahore.

MAJOR SCOTT, Superintendent of the Ishapore Gunpowder Factory, proceeds to England to watch the progress of the manufacture, both in public and private factories, of the new powders in connection with the army rifles. Lieutenant Carroll acts for Major Scott, who is accompanied to England by the master powder-maker of Ishapore.

A RAILWAY accident has occurred on the Madras Railway at the Timmacherla Station. The native driver of a goods train lost control over the engine, which should have been turned on the turntable, but instead of which it smashed the dead buffers and went down the embankment with two waggons. The driver was severely injured, and the guard slightly. The engine and wagons were wrecked.



## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

### "INFORMATION WANTED"—SUPPLIED.

SIR,—Replying to the enquiry of "X" in your issue of 23rd June, I venture to enclose a page or two from Trautwine's "Civil Engineer's Pocket-Book," which, if not too late, I trust may be of service. Mr. Molesworth, in his 21st edition (1886), quoted by "X," has given a list which we give (on page 411) as the "Birmingham gauge for sheet brass, silver, gold and all metals except iron and steel?" in which the small numbers correspond with the light thicknesses, as instanced by "X," while in the regular "B. W. G." for iron and steel the small numbers correspond with the heavy thicknesses, as in the new standard British and in our American or Brown & Sharpe's wire gauges.

It seems to have been thought desirable to add to the confusion of gauges by making two Birmingham gauges run in opposite directions.

In his 17th edition (1871) Mr. Molesworth gives a Birmingham gauge in which No. 1 =  $\frac{1}{312}$  inch and No. 36 =  $\frac{1}{104}$  inch, which agrees nearly with our figures.

JOHN C. TRAUTWINE, JR., C.E.

3301 HAVERFORD ST.,  
PHILADELPHIA;  
July 28, 1888.

### BENARES-CUTTACK-POOREE RAILWAY.

SIR,—In your paper of the 1st September 1888, page 164, on the Opening out of Orissa, you say the Government of India will be glad to entertain favorably any scheme for its development which may be put forward by private enterprise,—this refers to the Benares, Cuttack and Pooree Railway.

I think the Government have acted wisely in declining to burden the public revenues with a Railway that will not pay. During the three years that the line through Keonghur into Cuttack was surveyed, the two first years the parties failed, but in the third year a party located a line, which resulted in heavy cuttings, tunnels and embankments, to get down from the upper valleys to Cuttack; and the length of line had to be thus increased by about 15 miles. There is no trade; they could not find even a *moodee's* shop. They saw only a dozen pack bullocks in 60 miles; nine-tenths of the country is under jungles; there is no coal. I examined the country for minerals, but could only find iron ore; the country is unhealthy, thinly populated, and the inhabitants are fast dying out.

As the Hindu community is a large and wealthy body, I would recommend them to send a reconnoitering survey party, and carry a line from the Burdwan district through Midnapore and Balasore into Cuttack. Here the gradients will be easy, but the bridging will be heavy. At present there is through communication by rail and canal. Cuttack is well supplied with canals, which can carry goods cheaper than Railways to the ships at Chandbally.

Would it not be more prudent for Government to make Railways that will pay large dividends, and to open out more populous districts of Bengal and Behar.

August 4, 1888.

P. BURKE.

### TECHNICAL EDUCATION.

SIR,—Public attention in England is being seriously, persistently directed to the desirability, and more than that,—the need I might almost say—of artisan education in handicraft. Mr. Mundella deplores the lack of technical instruction for the English working classes, and holds that responsible for their failure to hold their own in competition with continental workmen. Mr. Oscar Browning says that English artisans are every year losing ground in the race of industry to the better-trained foreigner,—owing to lack of handicraft skill. Mr. Wilson, the Head Master of Clifton College, said the other day, that he returned from a visit to the continent with a feeling of humiliation, not unmixed with alarm, when he contrasted England's condition and prospects with those of her industrial rivals. The English Commission sent to the continent disparages the height, circumference, stamina, of continental operators. Thus—"Swiss workers are short and thickset in comparison with English ones." "The factory girls of Saxony are less comely than those of Nottingham." What on earth have aesthetic judgments of this sort to do with the subject? The hard fact remains that England's trade is being subverted by foreigners. England's persistence in free trade suicide has, of course, a great deal to do with this untoward result; but failure of technical education and handicraft is blameworthy in the matter too. What has become of, what has been the issue of the promising talk at the Convocation of the Bombay University about technical education and handicraft. Has it died, is it going to be allowed to die, a natural death? I hope not. That would surely be a pity. Inherited skill Indian artificers may possess to some

extent; but it would certainly be all the better for scientific training in the way best for it to follow after. Everybody acknowledges that a brain centre, called upon to be constantly serviceable, must be used and well used. Equally it is a matter of fact that hand centres, if they are to be serviceable, must be used and well used. Heredity, in short, in the matter of handcraft, can never supply the place of technical education, or offer adequate compensations for its absence.

ECONOMIST.

### ELEMENTARY DRAWING: THE FIRST STEP IN TECHNICAL EDUCATION.

SIR,—There are two points from which the introduction of technical training, in a systematic manner and under State agency, may be viewed—that of the people who would benefit by it, and the other of the Government which has to provide the means for it. The latter as the responsible keeper of the public purse is bound to act cautiously, and it is therefore only when the necessity for reform is proved that the machinery of the State can be set fairly in motion. There is now ample proof of the need of technical education of some sort, and the subject has apparently possessed the minds of the people: the Government of India, too, in a recent resolution refers to this need, admits that the time has come to take action, and points out the path to be followed.

The great flaw in the educational policy of the past has been the want of some definite end towards which study should be directed: this flaw has become all the more apparent of late owing, comparatively speaking, to the dearth of State employment. The teaching of mere facts and principles can be productive of no good to the individual, unless at the same time the physical faculties of observation, manipulation, &c., are trained to turn such facts and principles to useful purpose.

Now, however, that technical education is in its incipient stage in this country, and the exact form in which it will be inaugurated is left to be decided after a careful industrial survey, there is a step which may safely and usefully be taken, and in doing which no further time should be lost, *viz.*, the teaching of elementary drawing in all schools. It is universally admitted that whatever career a man may follow, he is always a better man if he is able to express his ideas in drawing, as well as in writing: but to the future technical student, and especially to the practical workman or superintendent of work-people, facility in drawing is an almost absolutely indispensable qualification.

It will, of course, be found necessary to insist upon the attainment of a certain standard of general proficiency before permitting a student to direct his entire attention towards either an advanced general or a special course of study. Thus a student would after going through a primary school continue his general studies in a secondary school, at the close of which period he would choose some special branch or profession towards which his future efforts would be directed. It is during this second stage that elementary drawing might with advantage be taught, because an early test can be applied as to correctness of eye and dexterity of hand, and the chances of mistaking one's vocation are greatly reduced. Besides, in having already learnt to draw, the technical student will have mastered some of the preliminary difficulties connected with his studies.

It is essential that the standard of general proficiency to be attained previous to launching out upon a course of technical education should not be a low one, as the value of such education depends upon a proper knowledge and understanding of principles, and upon the development of the reasoning faculties, without which the progress of practical science would be arrested, however skilful the aid of the artisan may be.

Two or three hours a week set apart for classes in drawing would, without appreciably disturbing the school routine, be sufficient for the elementary training recommended for all pupils between the ages of 10 and 16; the solution of the question as regards teachers is an easy one looking to the number of worthy pupils who have gone forth from the Calcutta School of Art.

SCIENCE AND ART.

### WESTERN BENGAL RAILWAY.

SIR,—In my first two letters I pointed out some of the advantages that would accrue to the Western Bengal Railway project. Let me now describe some of the disadvantages.

In his letter of the 11th June 1888, Sir Bradford Leslie, in para. 3, says:—"Excepting the bridge over the Sone River, there would be no works of extraordinary magnitude."

This is an ambiguous expression. If he means that there are no more bridges of the first-class, he is right, for there is only one Sone River, south of the Ganges, in Bengal or Behar, and it requires to be crossed only once, but besides the Sone River, there are many rivers to be crossed, which would be ranked, as 2nd, 3rd and 4th class rivers—at least three of them are as large as the Adjie and Morare Rivers, on the Loop Line of the E. I. R. The river at Gya, on the east of the town, will require a very large bridge, only second to the Sone. The Morare River, about 15 miles west of Gya, is another large river; 40 miles west of Gya, there is a third large stream. The first I saw and examined for



23 miles, the second and third I surveyed in connection with projected Railways between the Sone and Ganges. There are many second and third class streams between Gya and Nonihaut. Many bridges will be required, because the W. B. line crosses the watershed of the Hazaribagh highlands, and the same may be said of the line between Nonihaut and Kutwa. All these bridges will present no difficulties to Railway Engineers, but it will require a pile of rupees to do the work.

In para. 9, Sir Bradford Leslie says:—"There would be a large traffic in time from Rhotasgurbh, which would probably supersede the Kutni and Sylhet line in Calcutta." Let us look into this matter a little closer. The distance from the Sone to Calcutta will be about 375 miles, at  $\frac{1}{2}$  pie per maund = 10 annas 5 pie per maund, or Rs. 65 = 7 annas 8 pie per 100 maunds. Good lime is selling in Calcutta for Rs. 70 per 100 maunds. I paid from Rs. 30 to Rs. 50 per 100 maunds for lime at Dinapore on the Sone Canal. If the W. B. Railway takes lime at special coal rates,  $\frac{1}{2}$  pie per maund per mile, then the freight will be nearly Rs. 38 per 100 maunds. If Sir Bradford Leslie could run a branch line up the east side of the Sone River into the Palamow Coal Fields, and bring down coal and lime at low rates, he might compete with Sylhet in Calcutta, and cut out Giridhi in the markets of the North-West in supplying coal, for the branch into Palamow would not be over 70 miles long, and 70 more to Benares would be 140 miles, against 288 miles of the E. I. R.

It is true that something must be done to lower the rates and suppress the monopoly enjoyed by the E. I. R.; for good lime is very dear in Moorshedabad, Malda, Dinapore and Purneah; in the latter, it is now selling for 1 rupee 6 annas per maund; these districts import their lime. The E. I. R. Co.'s rate from Dinapore to Sahebgunge is 5 annas  $6\frac{1}{2}$  pie per maund. Coolie hire and crossing the Ganges is heavy; the rate to Rajmahal is 6 annas  $1\frac{1}{2}$  pie per maund. The boatmen and the Railway play into one another's pockets.

At present Purneah (not the Railway, but the inhabitants) pay 1 rupee 6 annas a maund for lime, 8 to 12 annas a maund for coal, 4 annas a maund for bad firewood. Over 3,000 maunds of firewood go to burn a lakh of bricks, which do not yield 50 per cent. of good bricks. Can one wonder that the natives will not use lime and *pucca* bricks in buildings. Coal could be delivered at 4 to  $4\frac{1}{2}$  annas per maund and lime from 8 to 10 annas a maund, when the new lines are made and cheaply worked, or when the E. I. R. bring down their rates.

I have no space to write about country produce, but may remark that the sections of country, on both sides of Gya, are about the most productive in Behar and the North-West of India. Western Sonthalia, on the whole, is a poor country for agriculture. Eastern Sonthalia, or the valleys of the Dominikoh, are about the most fertile in the world.

September 4, 1888.

P. BURKE.

#### PROFESSIONAL PAPERS ON INDIAN ENGINEERING.

SIR.—Some time last year I addressed you on a topic to which I again venture to allude, and that is the singular disinclination of the Government of India in the D. P. W. to make public to the world in general, and the Profession in particular, the results of some of its most recent and splendid undertakings—a modesty and reticence which is not altogether commendable, and a practice not, unfortunately, observed in other branches of the administration. An energetic Deputy Commissioner, with a hobby for gardening, tries to teach the zemindar improved methods of agriculture; he makes up ploughs that the cultivator will not buy; he introduces English vegetable seeds which the recipients *cheer* and expectorate, but do not sow. He makes a *silo* and poisons about a dozen animals in the nearest cattle pound with the contents thereof, and in his Annual Report he tells Government how he *did not* make sugar from sorghum juice, owing to his not being able to invest in a vacuum pan. These and other details, *ad nauseam*, are printed and circulated over the province, and not read by half a dozen people at the outside.

The Government constructs an important line of Railway costing some millions of money, and the road of which is carried over streams by bridges, the like of which are not to be seen in any other country of the world, save perhaps in America, beyond the dozen or twenty Engineers who have been engaged in the work not a soul else knows a single detail of what has been done. Here an enormous amount of matter of the highest professional interest remains a sealed book, and what would undoubtedly consist of information of the highest technical value to other men under similar cases is for ever lost.

The excuse, and one which is to a certain extent valid, is that the Government and its officials may say we have to get through an enormous amount of work with only just enough time to do it in, but we have no time to waste in writing about it. This is undoubtedly true, and it now becomes a question whether private enterprise could not step in and supply the Professional world with information of which it would gladly avail itself.

"Humber on Iron Bridge Construction," and "The Progress of Modern Engineering," by the same author, were considered most valuable additions to the literature of Civil Engineering—some years ago. Could not INDIAN ENGINEERING be made the medium of rescuing from oblivion the records of works which for magnitude and importance are second to none in the world?

I do not suppose the Government would have or could have any possible objection to make this information available; in fact, such a policy would be suicidal in the extreme: the only other question would be the one of expense, but here again your subscribers would willingly increase the rate of monthly or yearly subscription, and one or two or three papers on different works of importance might appear weekly as a supplement INDIAN ENGINEERING. Considering the scope that exists, and the enormous area of country of which works of great magnitude are extended with a little liberality INDIAN ENGINEERING might take its place (as a record of splendid work, and as a medium of conveying information of the highest practical value) with any journal of its kind in the world.

The N. W. S. Railway with its main lines and branches radiating from one centre over the whole of North-Western India, shews a series of works of every possible type from the practically dead level bee line from Lahore to Multan, 207 miles, without a curve to the gigantic bridges over the Sultej, Chenab, Jhelam and Indus. The heavy work between Jhelam, Pindi and the Indus, or in Beluchistan up the Bolan and Sind. Pishin sections, are undertakings embracing various types of construction and work. Now, would it not be possible to present to the Profession, both here and at home, some record of what has been done, and is being done in various parts of our Eastern Empire?

Members of the Legal and Medical professions are compelled, unless they wish to get rusty and run down, to keep themselves well posted in the latest theories, rulings and points involved in the most recent practice, and I do not think that in professional enthusiasm and devotion to their work the Engineers in India are one whit behind their fellows in any other country in the world. Moreover, when such important additions to their own technical knowledge could be acquired at such a comparatively trifling expenditure, it is scarcely to be supposed that they would grudge the cost.

I may add that a record or series of supplements to your journal would in itself constitute a manual of Civil Engineering not likely to be surpassed, if equalled, by any similar publication.

S. P. Q. R.

[The policy of the Government of India in the P. W. D. is rather to crush than encourage our efforts to supply complete records of important Engineering works projected or carried out in the country. It will surprise the world at large, and the Indian Profession in particular, to learn that this spirit of opposition has been carried so far by a certain clique that our request for admission to the Library of the Public Works Department at Calcutta was actually negatived. But we have survived the refusal!—ED., I.E.]

## Literary Notices.

A MANUAL FOR MUNICIPAL AND DISTRICT BOARDS. By J. A. Jones, M.I.C.E., F.R.S.E. Madras: Government Press. 1888.

Now that the scheme of Local Self-Government has been an accomplished fact in some shape or other throughout the country, it is the business of those who have undertaken the task of managing their own Municipal affairs to recognise the heavy responsibility attaching to those duties. Herein lies the secret of their success. Whatever might be said of the antiquity of the *punchayet* system, and its suitability to the conditions of Indian life, there can be no gainsaying the fact that the modern institutions, inaugurated under the auspices of the British Government, have no counterpart in any epoch of the past history of the country. The *punchayet* might have answered its purpose in the settlement of religious or civil disputes among those amenable to its authority, but it cannot for a moment be maintained that the members ever troubled themselves about the sanitation of a locality or the health of the people. It is easy to understand why such was not the case. Scientific appliances were then unknown, and epidemics which threatened to decimate the population were looked upon as visitations of an irate deity which must be propitiated by sacrifices. There was not a suspicion that they were the natural consequence of negligence and ignorance combined. Such instances are not rare even now. Sanitation, therefore, did not form part of their learning or creed, and since it is of modern growth, people must be educated in it. We are therefore glad to observe that Mr. J. A. Jones, M.I.C.E., Vice-President and Engineer of the Madras Municipal Commission, has published "A Manual for District and Municipal Boards" in Southern India, and that the author has acquitted himself creditably goes without saying. Of course, there is nothing positively new in the work, nor is it designed to benefit those who are already conversant with the subject. It is



his desire to instruct the members of the Board by bringing home to them in plain, simple language, devoid of technicalities, some startling facts in regard to the health and well-being of the 'masses;' and this he has accomplished in an admirable way which leaves nothing to be desired on that score.

The author starts with the description of 'dirt' as matter in the wrong place, and all his energies are devoted to teaching his clients, as it were, how to remove it altogether, or to a suitable place. He says what must be new to many members of the Municipal and Local Boards, that the causes of diseases are conveyed into our systems by means of the air we breathe, the water we drink, or the food we consume; and therefore the purer these are, the more remote are the chances of ill-health. The principal object for which those bodies have been appointed, is the removal of dirt. "It is not difficult to understand," says Mr. Jones, "that whether the work in hand be the construction and maintenance of roads, the laying down of sewers, the distribution of a supply of water, the draining of towns, vaccine operations, or even the collection of taxes, the end arrived at is either the removal of dirt or the protection against disease caused by the presence of dirt. There are, indeed, a few other duties cast upon these Boards, such for instance, as registration of births and deaths; but even this object is one intimately connected with those previously enumerated; as the resulting figures enable us to determine whether, and to what extent, our operations have acted for the benefit of the people, or shew how far we have fallen short of the result we desired to achieve." And the conclusion arrived at is, that the death-rate of any locality is a criterion of work done. If it is high, we have failed in our duty, and have permitted dirt to continue among us; while if it is low, then we may be sure that our efforts have been crowned with success, and this should encourage us in our endeavours to reduce the death-rate still lower. The rate of mortality, according to Mr. Jones, should not exceed 23 per thousand.

The next subject discussed is hygiene. It is pointed out what everybody should know that without pure air a high degree of health could not be assured. This is to be attained by the use of disinfectants, deodorants, ventilation, &c., principal among these being a consideration of the space occupied by each individual. In the barrack-rooms in India on the plains, 1,800 cubic feet and 90 superficial feet are allowed to each person; on the hills, 1,200 to 1,400 cubic feet, and 75 superficial feet; in native hospitals, 1,500 cubic feet, and 99 superficial feet; in jail, 648 cubic feet and 54 superficial feet. Cattle ought to have 1,000 cubic feet. Ventilation may be effected either by natural or artificial means; the former includes winds and differences of temperature; the latter, extraction or propulsion. Winds are great agents in ventilation, and it is to these we must trust in laying out streets, lanes, &c.

The author discusses the subject of water and its impurities in an admirable manner. Any man with ordinary intelligence should be able, after reading it, to find out for himself what are the compositions of water, and how it may be purified. The sources of its supply are rivers, tanks or other reservoirs, wells and streams. Ordinarily the largest supply is obtained from wells. The storage in them is nothing more than rain water, which has fallen and sunk through the land, and usually stands at the same level as the subsoil water around it. It follows that the purity of the water in a well is regulated by the soil through which rain has percolated, and on the external surface surroundings; if, therefore, we wish that its contents should be uncontaminated, the surface of the ground around it should be perfectly clean, and that there is no soakage of an impure matter into the ground near it. To quote Mr. Jones:—"A well, however, cannot be considered absolutely free from pollution except from matters fully half a mile distant from it in every direction. Soil will naturally act as a filter, and at first would do so; but all filters get dirty, and thus if excrementitious and other refuse substances are constantly on the ground within the drainage cone, the well water will become impure. Impurities will also pass into a well by

its mouth; winds will blow in dust highly charged with mineral and vegetable matters; floods will wash in every kind of impurity, organic, or inorganic; dirty vessels for drawing the water may pollute it; persons washing themselves near the well will allow the water to flow off them into the ground, and thus back into the well." It is therefore very dangerous to place water, whether for drinking or culinary purposes, near burial-grounds, slaughter-houses, cess-pools, sewers or surface drains, tanneries, or even cultivated fields, which have been manured, nor should they be kept in the vicinity of tanks where people resort for purposes of ablution. In order to secure the purity of water in a well, it should have a good parapet, a flooring round the mouth which will not permit any liquid to permeate through the soil, extending some ten or fifteen feet from it, a drain round this to receive water which may be spilled in drawing, and another drain to carry it away. To ensure great security from pollution, private vessels should not be permitted to be lowered into it, as there is a risk of contamination, to avoid which the well should be covered, and a bucket and pulley should be attached to it, or to arch wells over and fix pumps at them, or to pump the water from the well into a reservoir which might be furnished with taps from which people may take their supply. Then, again, wells should be pumped dry once a year. We have dwelt at length upon this subject, because, as we have said above this is the most ordinary method of procuring this necessary of life, and also to point out that the hot beds of epidemics may be distinctly traced to the impure water in reservoirs which are surrounded by huts, and to which the inhabitants resort indiscriminately for bathing, washing their clothes, and drawing potable water.

In writing about food, the author has been so particular in the details as to detecting unsoundness in it, that any one following the directions given will be in a position to detect any shortcoming by merely looking at it, whether it be grain, vegetable or animal food.

The subject next treated is conservancy and sanitation. Here some wholesome advice is given which Municipalities and District Boards should closely study, as the author very properly observes:—"Splendid water-supplies, fine roads, beautiful lamps, pleasant parks are things much to be desired; but if the soil and foundations of our dwellings are saturated with filth; if the air we breathe is impure, and we neglect to improve these before wasting money on the former objects, we shall be simply building a house of cards, which will fall to the ground in the face of the first epidemic which arises."

These are words of wisdom, and how they find application even in the City of Palaces was painfully exemplified when the subject of connecting the Howrah pontoon bridge with Sealdah by a broad road was discussed by its Civic Fathers. What a wail was raised that the plague spots in the Northern Division of the town were to be swept away. They had for upwards of a hundred years offered victims to the Moloch of cholera, fever and other scourges of humanity, and here was a pail of Western civilization brought to cleanse the town of these spots so endeared to those who live in closely packed *bustees*. We do not mean to support the authorities in the way they have proposed to compensate owners for the land acquired for the purpose, for a good deal of injustice will be worked; they might be a little more liberal. But when the whole town is to derive benefit by the opening up of bye-lanes, &c., we think that private interest should, to some extent, give way before public good.

We regret that want of space prevents our entering at length into an examination of the other subjects discussed by Mr. Jones with an ability, the result of practical experience. But in justice to him, it should here be stated that the "Manual" is a work which members of the District and Municipal Boards would do well to have at their elbow at all times. It will help them in moments of difficulty, at the same time enable them to generally dispense with constant references to professional men.



## General Articles.

### TYPES OF IRON GIRDER BRIDGES, INDIAN MIDLAND RAILWAY.

WE furnish the second of the series of Plates giving details of the main girders of these Bridges. The Drawings, as said before, are self-explanatory. The annexed Plate refers to the 100 feet clear span deck bridge, some particulars relative to which will be found in our issue of 25th August last.

### NOTES ON NAVIGATION.

BY A. EW BANK.

#### VII.

Fig. 12.

WE may now consider the case where in the preceding paper we had

$$\cot \gamma = \cot A - \sigma \sin l \sec^2 l \cos a, \text{ and where we take } 2$$

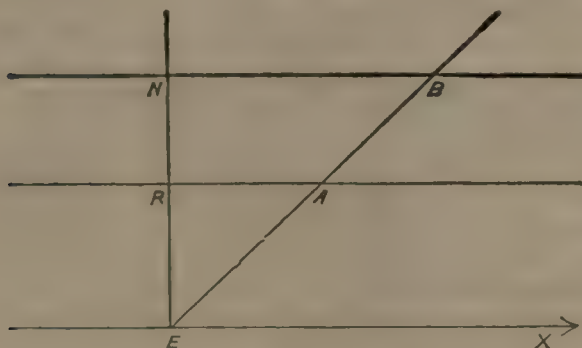
the point A of the small arc  $\sigma$  to coincide with E. See *fig. 12*. When A moves down to E we have  $\cot \gamma = \cot A$  by the above equation, while for other positions of A on the fixed circle E V we have  $\cot \gamma$  differing from  $\cot A$  by a small quantity.

When  $\gamma$  differs from A, the rhumb line A C B cuts the circle A S B at a small angle. When  $\gamma$  becomes equal to A, the rhumb line for the small arc A B must touch the circle at A. Thus our inference is as follows. If at E and for a very small arc E B we propose to draw the rhumb line, we shall find that the circle is its own rhumb line.

Thus that property which is true for the equator and for all meridians—be the arc A B small or large—is found to be true also for all great circles at one particular portion of each circle. The portion in question is that element of the circle which is at the equator. Strictly speaking, there are two such elements because the circle meets the equator in two places.

Further, to examine this matter let us consider *fig. 13*.

Fig. 13.



N E X is a sheet of paper or other plane surface. N B and R A are parallel to E X. E A B is a straight line making any acute angle with E X.

Now let the paper or other material be made into part of a cylindrical surface, of which E X, R A and N B will be generating lines. These lines remain unaffected by the folding of the paper.

The line E R N becomes a circle. It becomes a curve, but it does not cease to be a plane curve, *i.e.*, to lie in one plane.

The line E A B becomes a curve, but it is not a plane curve. Non-plane curves are called curves of double curvature. No four consecutive points of the curve E A B lie in one plane.

The curved line E A B becomes a screw line on the cylinder. Or we may call it a line of constant pitch. The pitch is the angle  $90^\circ - R A A_2$  or  $90^\circ - N B A$ . Strictly to describe the angle at B when E A B is curved, we should take a point B<sup>1</sup> in B A and near to B. Similarly we should take a point A<sup>2</sup> in A E and near to A. And we

should define the pitch as the angle  $90^\circ - R A A_2$  or  $90^\circ - R B B_1$ .

The curved line E A B might also be called a rhumb line on the cylinder. The pole of the cylinder may be considered to be at infinity, or the axis of the cylinder produced towards say the left of the figure. To this point or pole we may imagine that the parallel lines A R and B N are travelling or converging.

The rhumb line E A has a double curvature. Suppose that when the paper N X has been curved to form a cylinder we hold it so that the axis of the cylinder is horizontal and the line E X is the highest generating line of the cylinder. To make the idea further precise let E X point due east. Also let the angle A E X be  $45^\circ$ .

Then a small element at E of the line E R is still horizontal and points due north. A small element of E A is horizontal, and points north-east. These two small elements lie in the tangent plane at the point E. This plane is horizontal and contains not only a small element of E X, but the whole of this line.

Now the curve E R N has only a single curvature, we may call it a vertical curvature. The points R, N sink below the horizontal plane at E. But these points R, N do not get deflected horizontally or laterally. They may still be considered as being due north of E.

If now we consider the curved line E A B, we see that the arc A B also has a vertical curvature. A is a certain distance beneath the horizontal plane at E, B is a further distance below E. If the length of the original straight line E B be double of the straight portion E A, then in the curved line we shall have the depth of B below E more than double the depth of A below E. The depth of B equals that of N, and the depth of A equals that of R. If E R = R N the depth of N is more than double that of R. In fact, in this case the depth of N is to that of R in a ratio which is as 4 to 1 for small arcs E R, R N, and which gradually lessens as E N approaches a quadrant. The value of the ratio is then  $2 + \sqrt{2}$ . If we have E N a semi-circle, the ratio reduces to 2. Thus the depth of N is always more than treble of the depth of R as long as E N does not exceed a quadrant.

For a curve which is not a circle other ratios will, of course, obtain.

The curved line E A B besides shewing a certain varying vertical curvature has a lateral curvature, also varying, which may be illustrated by *fig. 14*.

E X B N is a plane rectangle of paper. E X has some length C and E N, the breadth of the paper, is  $\frac{\pi r}{2}$ . Accordingly the paper may be folded or rolled so as

to form one quarter of a complete cylinder. In this case the radius of the cylinder will be  $r$ .

The line E N becomes the quadrant E H. The equal line X B gives the quadrant X K. The line E B forms a curve which starts from E and reaches K. This curve on the cylinder is not shewn in the figure. D L is now the axis of the cylinder. D L C F is a horizontal plane parallel to the plane E X B N.

Let the curved line into which E B is bent be projected orthogonally on the plane D L C F. We thus obtain a curve D K. D C is the projection of E B. The curve D K touches D C at D. At K the tangent line to the projection would be a line parallel to D L or E X.

The projection D K illustrates the varying lateral curvature of the original line E B on the cylinder. But it shews nothing of the vertical curvature of E A B.

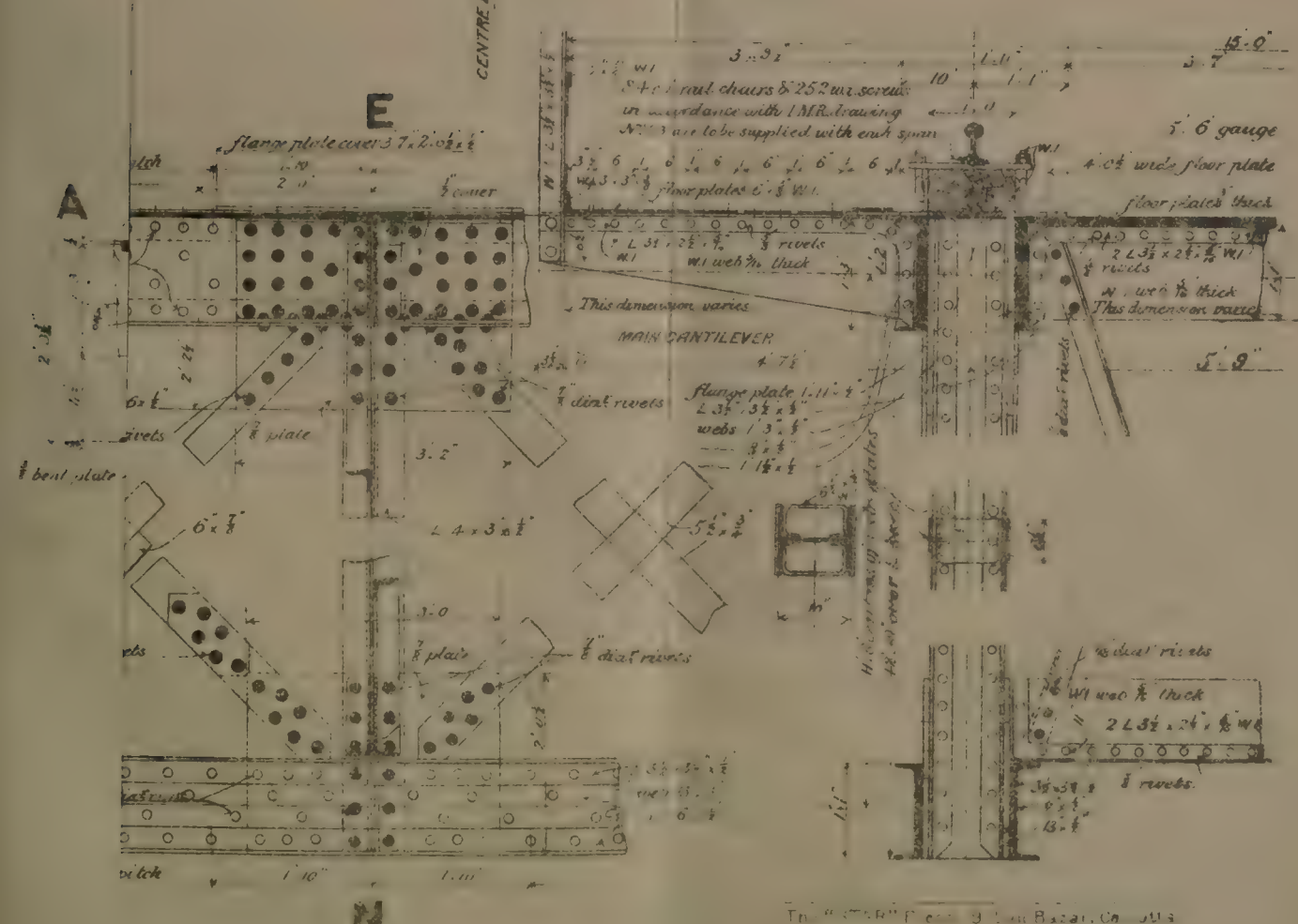
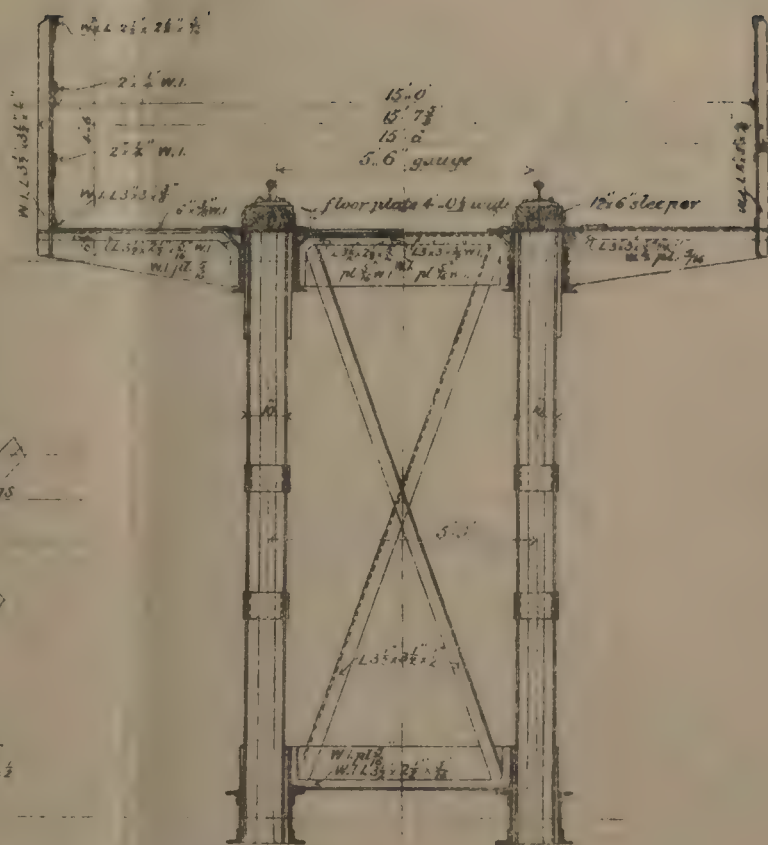
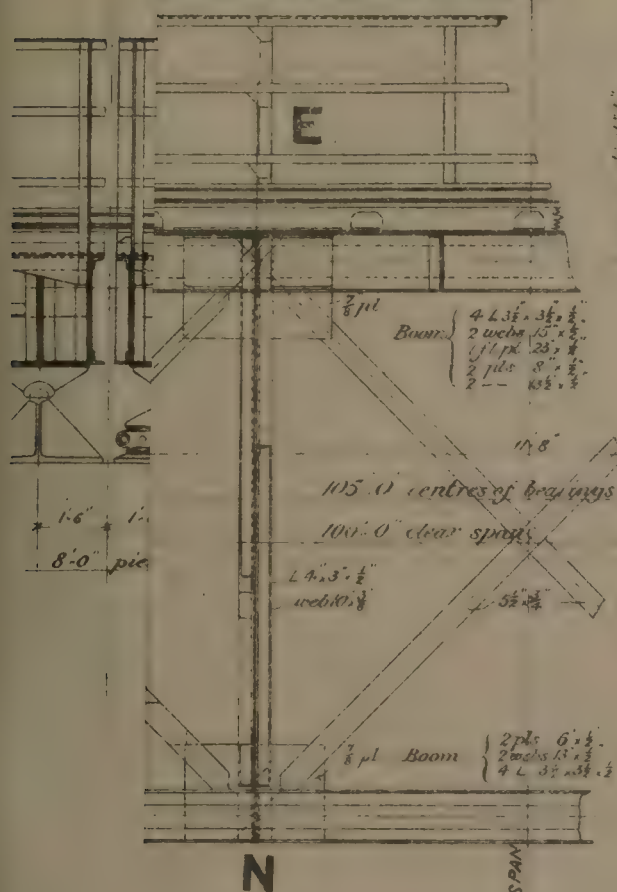
The movement of a point along the curved line E A B, of *fig. 13* as far as its horizontal velocity is concerned, is initially north-east. Its horizontal component of velocity then gradually changes, until at K it becomes due east.

Thus we see the lateral curvature illustrated. At E the moving point has no vertical component of velocity. At K the real curve has an inclination downwards of  $45^\circ$  to the vertical. Here we see the vertical curvature illustrated.



length of span 107'-9"

E BUILT WITH 2" CAMBER AT CENTRE









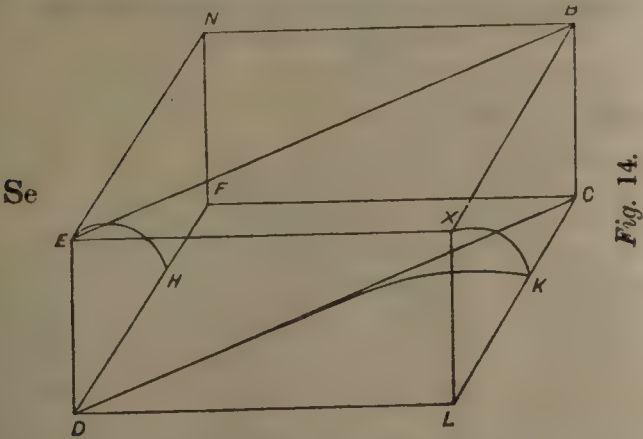


Fig. 14.

If in *fig. 14* we produce *N E* and *B X*, so as to make another rectangle equal to *E X B N*, and having *E X* as one side, then beneath this new rectangle we may imagine the other upper half of the cylinder to be formed. If we produce *X E* to *Y* so that *E Y = E X*, then on each side of *E Y* we can form another quarter of a cylinder. Through the axis *D L* we have the horizontal plane *D L C*.

We then obtain such a figure as *fig. 15*. This may represent the projection of the four upper parts of the cylinder already mentioned. *K D* is the same curve as in *fig. 14*. At *D* the curve crosses its tangent line and forms a portion *D M* equal to *D K*.

This projection *K D M* shews a point of inflexion. But in the original rhumb line *E A B* there is no point of inflexion. A rhumb line or screw line on a cylinder is such that every element is similar and equal to any other element. Such a curve would not shew a point of inflexion.

In *fig. 7*, where we projected a spherical rhumb line on the equator, we had a real point of inflexion at *M* in the original curve. But there is not a point of inflexion at *M* in the projection. Here then we have the converse case where a point of inflexion really existing is suppressed in the projection. In reality the rhumb line *A M J* crosses the equator. But in the figure it appears as if the rhumb line did not cross, but touched the equator at *M*.

Now the straight line *S D C* in *fig. 15* is a tangent to the projection *M D K*. On the cylinder is the real rhumb line passing through *E*. To this rhumb line the straight line *B E* or *B E* produced is a tangent.

Through the line *B E* draw a vertical plane. This will cut the cylinder in a plane curve, which is an ellipse. This curve also touches the rhumb line at *E*. The rhumb line crosses at *E* the plane of the ellipse. But the direction at *E* of an element of the rhumb line is identical with the direction of an element of the ellipse. In fact, each touches the line *E B*.

Now (*fig. 16*) on a globe draw *Q M R*, the equator, and *L M K*, a great circle cutting the equator at an angle *a*. Along a small element *M T* of *M K* draw a rhumb line and produce it. This rhumb line will touch the circle *M K* at *M*, and will then leave *M K* and pass north of *M K*.

If we produce the rhumb line backwards, it will give the curve *M J* which is south of the circle *M L*. Conversely, if on the given circle *M K* we take an elementary arc *M T*, and propose to draw the rhumb line through the extremities *M* and *T*, we find it coincident with the great circle arc *M T*.

This is the reason why in equation (18) which is  $\tan \gamma - A = \sigma \sin l \sec^2 l \cos a$  we have the angle  $\gamma - A$  exactly zero when  $\sigma$  is the small arc *M T*.

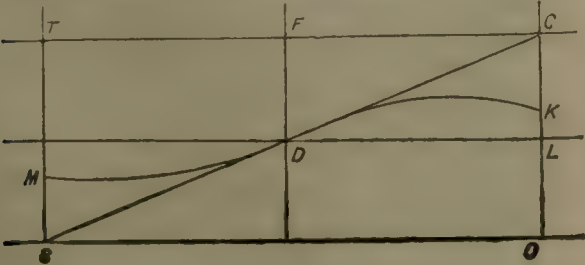
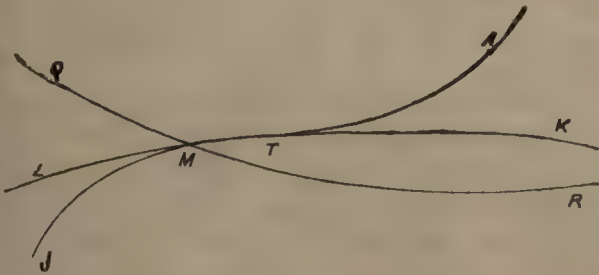


Fig. 15.

In a plane curve like *M D K* of *fig. 15* the curve loses its curvature entirely at *D*. The curvature at *M* is in one direction, and that at *K* is in the other direction. The curvature changing gradually between *M* and *K* passes naturally through the value zero.

Fig. 16.



Now for *fig. 16* let us hold the globe so that *M* is the highest point.

Then the circle *L M K* is to us a vertical circle. We may so hold the globe that this vertical circle is in our meridian. We may then say that *L M K* is a curve which has a vertical curvature, but has no deflection east or west.

To a point moving on the rhumb line are *J M* from *J* to *M*, there is a variable westerly deflection which is continually decreasing and becomes zero at *M*. Then the point must be moving due north as seen by the man that holds the globe. The north direction is given by the pole of our earth, and not by the pole of the globe held in the hand.

If the rhumb line had not a point of inflexion at *M*, the moving point would at *M* begin to have an easterly deflection as measured by the true compass. But, as a matter of fact, the moving point having reached *M*, begins to recover its westerly movements.

The curvature which it has lost at *M* is an east and west or lateral or horizontal curvature. The great circle *L M K* has no lateral curvature. It is, if examined for lateral deviations, found to be, as it were, straight. And this circle bears the same relation to the rhumb line as does the straight line *S C* of *fig. 15* to the curve *M D K*. At the point *M* the rhumb line has lost the curvature we are calling horizontal but it retains the curvature we call vertical. In fact its curvature for the moment is that of the great circle *M K*.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.  
XXXVII.

TEAK-WOOD work ordinary. In trusses, door frames, partition, quarterings, &c.

Items per c. ft. (1)	No. or Quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—		Variable.	Do.	Do.
Carpenter	No. ...			
Coolie	" ...			
Carriage	" ...			
Sundries	" ...			
Materials.—		Variable.	Do.	Do.
Teak-wood, includ- ing waste	c. ft. ...			
Sundries	" ...			
Petty Establishment	" ...			
Total per c. ft.	" ...			



# ON THE ERECTION OF GIRDERS, SOHAN BRIDGE, PUNJAB NORTHERN STATE RAILWAY.

BY MR. H. B. MOLESWORTH, LATE ASSISTANT ENGINEER, P. W. D.

IN accordance with orders received from Mr. F. L. Dibblee, Engineer-in-Chief, Punjab Northern State Railway, Ratiál-Pindi Section, I took over charge of the Sohan Bridge Sub-Division on the 18th July 1880.

The state of the works was then as follows:—

**Masonry.**—The masonry of the bridge was practically finished.

**Staging.**—The iron staging which had been erected had been partially washed away by heavy floods, and only that of two spans, Nos. 1 and 5, and one pier of staging for No. 4 span, were still standing. Of this staging, span No. 1 was nearly complete; No. 5 span was commenced, but only about  $1\frac{1}{2}$  lengths of staging were erected.

**Girders.**—The right hand plate girder of the south 80 feet span had been rolled across, and was nearly in position.

**River.**—The river was in heavy flood, but the water was rapidly falling.

Before detailing the means employed in erecting the girders, a short description of the Sohan river and the Bridge will explain the difficulties met with and the precautions required.

The Sohan river has a rapid fall, and a bed composed principally of shingle, small boulders and sand. The proximity of the hills makes the floods very sudden, and their duration is usually short. During the months of July, August and September, slight floods are of almost daily occurrence, and the continuance of low water can never be counted on for more than a few hours.

A sketch plan (*Plate I*) is annexed shewing the set of the current, a reference to which will serve to illustrate the following remarks:—

Span No. 1 was not much affected by the floods, as the current was deflected towards the opposite bank by a spur of rock. The iron staging therefore was perfectly safe in this span.

In span No. 2 the current ran much more strongly, and the iron staging which was erected there was undermined by the current and fell.

In spans Nos. 3 and 4 the full force of the current was exerted, the staging of span No. 3 failed completely, and only one pier of staging was left intact in No. 4 span. This staging was built on a foundation of piles and stood all the subsequent floods, when protected by a groyne and sand bags.

In span No. 5 the staging stood, there not being much flow.

The Government of India attached such importance, in a military point of view, to the completion of this important link in the frontier system of Railways, that they were prepared to risk the loss of a spare span of girders rather than wait until all danger from floods was at an end—a procedure which would have involved a delay of several months.

It was therefore determined, in spite of the previous failure of the staging, to erect the girders during the rains, and a trestle staging was adopted at the suggestion of Mr. F. L. Dibblee, Engineer-in-Chief, for the 3 spans in which the difficulty of obtaining foundations precluded all intermediate supports.

The trestles were made of Derrick poles (pun spars), which were braced together and strengthened with sleepers.

These trestles rested in recesses cut in the piers, and were in all cases put together on the ground and hoisted entire; the diagonal bracing was simply timber of small scantling, such as off-cuttings, rafters, &c., dogged firmly in place.

(To be continued.)

# DIFFICULTY OF MAKING STRUCTURES WATERTIGHT.

S. TOMLINSON, ASSOC. M. INST. C. E., F. R. MET. SOC.,  
*Deputy Executive Engineer, Municipal Water-Works, Bombay.*

THE difficulty experienced in making reservoirs and tanks watertight arises from the physical properties of matter, and is therefore not lightly got over.

Water possesses considerable specific gravity which causes it to exercise great pressure, and at the same time it possesses a splendid mobility. These two properties combine to make its power of escape from any vessel very great: the difficulty is to secure a structure of sufficient strength and impermeability by a practicable expenditure of money.

It is generally held that all matter is built up of molecules of extremely minute dimensions. In a simple substance or element therefore there must be spaces of greater or less extent between these ultimate molecules whether in a solid or liquid condition, the molecules cohering together. In any other than an element and more especially in all building materials, such as stone, brick and lime, there are several constituents and the porosity is greatly increased, because there is now also not only the cohesion of similar particles, but the adhesion of dissimilar particles introduced. The porosity of building stones and materials differs widely. In the case of unglazed bricks, for example, there is no difficulty in a person maintaining a pressure of 2 or 3 inches of water after forcing the current of air from his lungs through the brick. They freely absorb water as every one knows, and under pressure they freely exude water. From this extreme porosity there are all characters up to the almost impermeable basalts and granites which scarcely absorb any water at all. These last are the most suitable materials for masonry, subject to hydrostatic pressure, provided a cementing material of equally suitable quality can be met with.

I need scarcely say that cementing materials differ widely in character, and the very greatest care is necessary to prevent failure and disappointment. The most reliable cement known is undoubtedly Portland cement, which is a prepared calcined mixture of lime and clay. Not only is it the best cementing material, but of itself only it forms a strong artificial, and almost impervious, stone. The great advantage, it seems to me, of Portland cement as a cementing material for fine grained stone, such as basalt, lies in the extreme fineness of its particles, almost the whole of which in the best cement will pass through a sieve of 2,500 meshes to the square inch. The use of Portland cement is however more costly than lime, especially in this country, where freights alone double its cost, and the use of the natural limes of the country will be largely continued. The results in various cases will depend upon the quality of that lime.

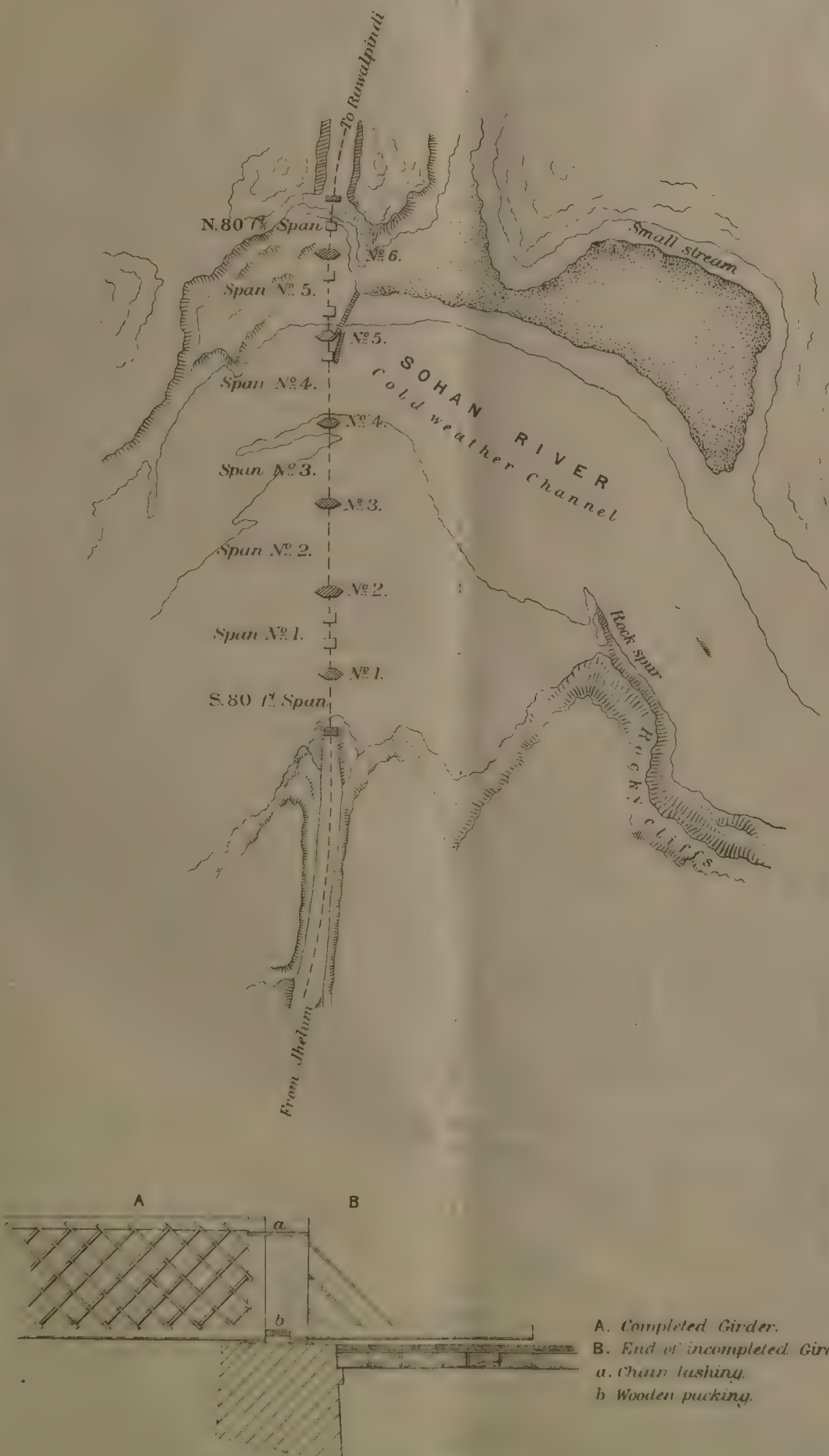
The face of a wall is usually dealt with in a special manner either by plastering the whole face of it or by pointing the joints.

As has been remarked, glazing or plastering is absolutely necessary over brickwork, which is so notoriously porous. The case is different, it seems to me, with the faces of walls built with almost impervious basalt. No plaster can improve the stone itself, and as compared with pointing in such a case I believe plastering is inferior in its durability and effectiveness besides being much more costly. My reasons for saying this are:—

1. Under the extreme changes of temperature and condition a large surface of plaster is certain to crack. Any failure involves not only the disturbance of the plaster immediately concerned, but affects, through the continuity of the plaster, the surrounding work.
2. In the case where any back pressure is liable to occur through the accumulation of water outside a wall. In the case of pointing the water might force its way out at one or two points leaving the



SKETCH PLAN OF SOHAN RIVER AT SITE OF BRIDGE.









other parts unimpaired. In the case of plaster the result would probably be the dislodgement of a considerable area of surface.

3. In the usual case of almost vertical walls. Whilst pointing rests securely within the joint and has the full advantage of both adhesion and gravitation to keep it there, plastering on the other hand is under the adverse influence of gravity, and this tendency is only resisted by its adhesion to the surface of the wall and the locking of the joints.
4. The chances are that in actual work the materials will be forced into and pressed against the surfaces of the stone by pointing than by plastering, and the joints only require attention.
5. Pointing is more easily repaired if it should become damaged from any cause.

#### NOTES FROM HOME.

(From our own Correspondent.)

THE London and North-Western Railway has accelerated its Scotch express, and much attention is now directed to the race which is now going on between the East and West coast routes to Scotland. The train which leaves Euston at ten o'clock makes the run to Edinburgh in eight hours and the first train arrived at the Northern terminus eight minutes before time, the journey having been accomplished with ease. A correspondent of the *Times* who accompanied the train gives some interesting particulars of this excellent performance. He says that between Creine and Preston a mile was covered in  $48\frac{1}{4}$  seconds, which equals 74 miles an hour. The engine that performed this work was built no less than twenty-five years ago at Creine by Mr. John Ramsbottom, who was then Chief of the Mechanical Department of the North-Western Railway, and is now a Director of the Lancashire and Yorkshire. It is of what is commonly known as the Ramsbottom type, with driving wheel 6 feet 6 inches in diameter and cylinders 17 by 24.

Up to the present date the East Coast Companies announce no further struggle. The Midland, notwithstanding it runs to Edinburgh in 23 minutes less than last year, is now an hour and three-quarters behind the other lines.

Such of the Railway Reports as are at present published shew a fairly satisfactory and general progress for the half-year. In several it is to be observed that first and second class passengers still shew a tendency to go third. The Great Western Company, among other things, have decided to carry on the steam packet service between Weymouth and the Channel Islands. The Corporation of Weymouth is to widen the harbour to accommodate the three new boats the Great Western will build by the summer of next year.

The Channel passenger traffic between Dover and the Continent has grown to extraordinary dimensions this season. An average of sixteen hundred persons per day, or about 12 thousand during the week, are now crossing the English Channel. So exceptional is the traffic that the midday expresses occasionally have to run in two parts. It is noticeable that there is a considerable increase this year in the number of foreigners visiting this country. Owing to the growth in the traffic the London, Chatham and Dover Company have decided to lay down another steamer, which will be built on the Clyde.

A contract for Captain Ead's proposed ship railway across the Isthmus of Tehuantepec from the Mexican Gulf to the Pacific has been recently let. The work is to be completed according to present arrangements in five years.

An Italian Engineer has just completed the survey of a proposed canal across Italy, the object of which is to save the long journey round Cape Leuca. This canal would begin on the western side near Castro on the Tyrrhenian Sea, and reach the eastern coast at Farro on the Adriatic. Its length would be about 180 miles, and its proposed breadth 110 yards, and its depth 40 feet. The estimated cost of the undertaking, including draining two lakes, is 20 millions sterling.

The Civil and Mechanical Engineers' Society paid a visit last week to the pumping station of the London Hydraulic Power Company, now in course of erection in Mill Bank Street, Westminster, and also the pumping station at Falcon Wharf, Blackfriars. This week the same Society pay a visit to the Tower Bridge works.

The total length of the Tower Bridge will be 940 feet opening span width 200 feet, opening span headway when opened 135 feet, opening span headway when shut 29 feet 16 inches. Headway of side spans from 20 to 27 feet. Width between parapets 60 feet. Depth of water at high water 33 feet 6 inches, and at low water 13 feet 6 inches. Steepest grades of approaches 1 in 40 (the steepest gradient of approaches to London Bridge is 1 in 7).

The verdict of the Coroner's Jury in the Hyde junction Railway accident (Manchester, Sheffield and Lincolnshire Railway) is one of "accidental death." The catastrophe it has been shewn was caused by a broken axle, and an eminent Consulting Engineer, who was called before the Jury, stated that the insipient fracture in the metal could not have been discovered unless the wheel had been taken off. No ordinary tapping would have discovered the fracture. This seems to take away a great deal of the confidence which has heretofore been reposed in the result of the functions performed by the "tapper."

The autumn meeting of the Iron and Steel Institute will be held in Edinburgh during the three days commencing 22nd August next. A list of seven papers is published, and amongst these are "The Forth Bridge," "The Metallurgical Exhibits at the Glasgow Exhibition," by W. J. Millar; "A New Form of Pyrometer," and "Testing Machines."

The Mechanical Engineers have held their summer meeting this year at Dublin, so that during the last three years that Institution has held its meetings in the three capitals, and it is intended to extend the principle, and next year it is proposed to hold the meeting in Paris. If such be carried out, no doubt it will be a great success.

The naval manœuvres now being carried out afford plenty of practical lessons to the Marine Engineer, and not the least is the failure of many ships to develop the speeds promised—and the great necessity of the establishment of swift cruisers.

#### THE INDIAN COAL FIELDS.

(From our own Correspondent.)

A CHANGE has come over the whole scene since I had last the pleasure of addressing you. The oppressive heat of June, which has become historical in the annals of Indian meteorology, and had well nigh "taken all the bones out of the people," as Kaffirs would say, has given place to a refreshing and delectable season, and we are now enabled to gather our scattered senses together, in order to contemplate the past, the present and so much of the future as human intellect can reach or penetrate.

Some of the events of the month referred to are doubtless still fresh in the memory of the reading public, and their repetition here will, I trust, be not objected to by the readers of INDIAN ENGINEERING.

Meteorologically speaking, the temperature of the plains had turned the heads of many, and on its onward sweep to the hills affected even the inhabitants of the Olympic heights of Simla. For it was during this sudorific period that an edict came, or was sent forth, from the disturbed brains of the generous—ungenerous is the right term—Minister of the P. W. D. to subsidise a rival Engineering journal to the manifest loss and injury of the journal whose destinies are entrusted to such able editorial hands as yours. It is believed in some quarters, not properly informed, that an exemplary policy of the highest order is enshrined in this very *political* move, but the intelligent section of the public, aided by side-lights and the moral sense of right and wrong, characterise it a policy of demoralisation, which, I regret to say, permeates every organisation in the country. We had hoped that the mantle of Sir Theodore Hope had fallen on a man who would not be moved by feelings, *personal* and *political*—the only two reasons which can be assigned for this act of *jobbery* and *corruption*. Sir Charles Elliot should remember that "To the Public good" "Private respects must yield." The conclusion that many with whom I have conversed have arrived at is, that our P. W. D. Minister is either made of 'elements weak,' or that he is governed by the voice of an *entourage* which is *weakness* itself. This is not to be wondered at as—

The veriest hermit in the nation,  
May yield God knows to strong temptation.

From what I have been able to judge from the conversation I have had with some members of the profession, you will be supported through thick and thin to the last. They despise the spirit that could descend to such low levels.



The agricultural classes experienced an unfavorable season last year, and if the present season, regarded as prognosticative of plenty, fails, like its predecessor, scarcity, if not actual famine, will be the result.

I have in vain endeavoured to generalise facts demonstrative of progress or improvement in the method of producing crops in rotation; but one or two circumstances that have come under my observation are exhibitiv of a gradual change that is coming over the agricultural mind, which is too cautious to indulge in new departures unless commensurate with expectations and attended with beneficial results. The kindly feeling of the ryot towards the light ploughs manufactured at the Burrakur Iron Works, and the rapid manner, after many years of lecturing and experimenting, in which the various types of sugarcane mills are replacing the rude and unsightly invention of the Indian ryot, who at length has come to recognise and appreciate the economical features of the European machine, are signs which mark a new epoch in the history of agriculture in this country.

The Agricultural Department has done much to disseminate knowledge, practical and theoretical, among Indian ryots, who are often stigmatised as ignorant and obstinate, prone to follow the footsteps of their forefathers, but with what success we are not told. What is really needed to bring conviction to the minds of these men is experimental farming diffused all over the country to enable them to rise superior to their present abject position. The Indian ryot, as I said, is too cautious and obstinately averse to a change of course, which to his mind appears *prima facie* problematic or involved in uncertainty, and unless the advantages of scientific husbandry are practically demonstrated by a series of beneficial results, the ryot of to-day will not be found a willing convert. It is therefore of utmost importance that attention should be paid by various local Governments and intelligent zemindars in furnishing examples of skilful management to their tenantry and neighbours, and which, when proved successful, will never fail of being adopted by them.

A great deal was at one time said and written about agricultural schools and centres being established all over the country, but now-a-days we hear very little about them or their doings. Like all institutions of incipient character, which languish or die out before their utility is felt for want of well directed and zealous efforts or imperfect organisation.

The 'ever whirling wheel of change' has opened out a vista of good prospects for the Bengal Coal-fields. The raisings have steadily improved, and while trade has, *pro tem.*, declined, stocks have everywhere increased to an enormous extent, to be cleared shortly under the auspices of Father Pluvius who, by-the-bye, is blessed by some and cursed by others!

The New Beerbhoom Coal Company has done excellent work during the six months ended 30th April, under the able and intelligent management which has hitherto characterized the operations of this Company. The raisings of steam and rubble from their collieries at Munglepore, Dhadka, Belroi and Borrea during the half-year under notice aggregated maunds 26,61,090, against maunds 23,39,115 raised in the previous half-year, or an increase of maunds 3,21,975. The deliveries amounted to maunds 23,13,410 which, as compared with maunds 20,67,381 delivered in the half-year ended 31st October, shewed an increase of maunds 2,46,029, including the delivery of maunds 135,131 of coke, as against the previous half-year's delivery of maunds 28,875. The stocks after delivery amounted in the aggregate to maunds 12,31,010, valued at Rs. 1,18,411-9-6. The operations of the half-year referred to resulted in the net gain of Rs. 72,565-4-11 equal to 10 per cent. on the paid-up capital of Rs. 7,20,000, or equal to 20 per cent. per annum—a result which should satisfy the most fastidious investor, and project in relief the management as the ablest that has yet administered the affairs of the New Beerbhoom Coal Company. The Manager and staff may well be proud of the results achieved, and sing in a chorus of jubilant voices—

"Conquer we shall, but we must first contend  
"Tis not the fight that crowns, but the end."

The Equitable management has undergone a thorough re-organisation, and if we are to judge by the results of the half-year for which the accounts have been made up and presented to the shareholders, it bids fair to outdo past efforts and to withdraw from the slough of despond into which its affairs have fallen. Notwithstanding this ray of light that has illumined the prospects of this Company, the trail

of the serpent still seems to pursue its operations. The Company, I am informed, is in throes just now in consequence of a serious Civil suit like the sword of Damocles hanging over its head. The claim is laid at the enormous sum of over half the capital of the Company, and with damages, consequential and otherwise, it is stated likely to touch the unfavorable side of 5 lakhs of rupees! But this is not all, for we are told that just at a time when prospects are improving by the construction of the Bengal-Nagpore Coal Branch to the collieries in the neighbourhood of Desherghar and Sanktoria, the Company has thought it opportune to part with one of its promising collieries, through which the line passes, for the insignificant sum of Rs. 12,000, after spending nearly as much on it! This is a move in the wrong direction, and not at all flattering to the wisdom that has dictated the bargain.

Efforts are doubled at Desherghar to meet the large demand that must necessarily follow the opening of the Coal Branch now in active construction. Deprived of the enmeshment which is the Company's own making or weaving and, with conditions favorable to a sustained large output, the *affaires* of the 'Equitable' should enter a prosperous phase. The present colliery management and staff are all that could be desired, but when their efforts are chilled by wars and rumours of wars, internal and external, supplemented with other difficulties, such as mechanical, manual and elemental, the result cannot be expected to be satisfactory.

The operations of the Bengal Coal Company during the past half-year for which the accounts were closed, was of such a satisfactory character that, after providing for a dividend at 6 per cent. for the half-year and paying all liabilities in the shape of commissions, &c., they carried forward to the reserve fund a very large sum as provision against heavy expenditure in the coming or current half-year. This ominous and fear-inspiring provision has set the brains of the mining community at work, who are unable to divine rightly as to what does it all mean. So far as I am able to guess, this abnormal provision for new works can only mean extensions at Sanktoria, Sodhpore, Liakdee and Kuldia and re-opening of Chinacoree, once in contemplation. The Bengal possess most extensive and valuable coal lands in the Burdwan and other coal-bearing districts, and if they only wished they could meet the requirements of the whole market alone, or singly, but circumstances have proved stronger than their inclination, which was once boastfully expressed as being nothing short of deluging the market; and as time speeds on the difficulty will become more pronounced. The affairs of the Company are in good hands, and so long as zeal, willingness and energy characterize their efforts, the prosperity which has hitherto attended their operations shall continue.

The doings of the Burrakur and the Alipore Coal Companies, managed by the well-known firm of Messrs. Bird and Co., are marvels in the annals of Indian coal-mining. The mammoth open work at Burrakur, or rather Kumardubi, is as methodical and precise as the more intricate operations at Alipore, and the results, separate and combined, do honor to the Agents and those employed under them. The Manager has perfect control over his men—mostly appointed by him or under his advice—and the good understanding that prevails between the members of his staff is productive of good results. Mr. Earpe has just completed a boring for coal, which has unhappily fallen on a fault. It is 550 feet deep,—the deepest yet accomplished in the Black Country of India. A new site will soon be determined upon and operations commenced; this time it is hoped he will be more successful in the discovery of the mineral which eluded him on the last occasion.

(To be continued.)

## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

#### Burma, August 25, 1888.

With reference to *Burma Gazette* Notification, dated the 17th August 1888, Mr. E. W. Oates, Executive Engineer, made over, and Mr. H. Hoyle Fox, Executive Engineer, received charge of the Rangoon Division on the afternoon of the 21st August 1888.

#### Madras, August 28, 1888.

The following transfer is ordered at the public expense:—  
Captain L. Langley, R.E., Executive Engineer, 2nd grade, sub. *pro tem.*, from the Trichinopoly to the North Arcot Division.



The services of Mr. C. A. Smith, Executive Engineer, 4th grade, temporary rank, are placed at the disposal of the Local Fund and Municipal Department.

Mr. J. Inglis, Assistant Engineer, 1st grade, is granted furlough on medical certificate to 13th August 1888, in extension of the leave granted to him in Notification published in the *Gazette* of 24th July 1888.

Mr. A. C. Pereira, Assistant Engineer, 2nd grade, is granted examination leave for three months, from 1st October 1888, or date of departure.

The following intimation, received from the Secretary of State, is published :—

Mr. H. H. O'Connell, Assistant Engineer, 1st grade, Madras. One month's furlough extension.

#### Bombay, August 30, 1888.

Mr. W. L. Strange is appointed to act as Executive Engineer, Bijapur, during the absence of Khan Bahadur Furdoonjee Cooverjee Tarapoorvala on privilege leave, or until further orders.

#### India, September 1, 1888.

Major T. B. B. Savi, R.E., Executive Engineer, 1st grade, State Railways, is granted special leave for two years under the terms of Public Works Department of 3rd October 1887, with effect from the 18th October 1888, the date of expiry of his present furlough.

The services of Mr. H. S. Talbot, Executive Engineer, 4th grade sub. *pro tem.*, State Railways, are temporarily placed at the disposal of the Foreign Department for employment in the Gwalior State.

The following permanent transfers are ordered :

#### To Burma Provincial Establishment.

Mr. F. H. W. Morse, Executive Engineer, 2nd grade, sub. *pro tem.*, from State Railways.

Mr. H. O. Walling, Assistant Engineer, 1st grade, from Bengal.

Mr. C. C. S. Clark, Assistant Engineer, 1st grade, from North-Western Provinces and Oudh.

Mr. J. W. L. Tooze, Assistant Engineer, 1st grade, from North-Western Provinces and Oudh.

#### To Rajputana and Central India.

Major L. F. Boileau, R.E., Executive Engineer, 1st grade, from North-Western Provinces and Oudh.

#### To State Railways.

Mr. O. J. Shedlock, Executive Engineer, 4th grade, sub. *pro tem.*, from Burma Provincial Establishment.

Captain J. Burn-Murdoch, R.E., Executive Engineer, 3rd grade, sub. *pro tem.*, State Railways, is permanently promoted to that grade, with effect from the 10th June 1887.

The Governor-General in Council is pleased to order the following promotions and reversions of Executive and Assistant Engineers, attached to State Railways, with effect from the dates specified :—

Mr. E. J. Moore, from Executive Engineer, 1st grade, sub. *pro tem.*, to Executive Engineer, 1st grade, permanent rank, with effect from 17th February 1888.

Mr. H. W. Warden, from Executive Engineer, 2nd grade, to Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 17th February 1888.

Mr. P. Duncan, from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 17th February 1888.

Mr. H. T. Gwyther, from Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 17th February 1888.

Mr. W. Michell, from Assistant Engineer, 1st grade, to Executive Engineer 4th grade, permanent rank, with effect from 17th February 1888.

Mr. A. Greenless, from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 17th February 1888.

Lieutenant E. W. Walton, R.E., from Assistant Engineer, 2nd grade, to Assistant Engineer 1st grade, permanent rank, with effect from 1st March 1888.

Mr. W. J. Weightman, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 5th April 1888.

Mr. P. Duncan, from Executive Engineer, 2nd grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, with effect from 8th April 1888.

Mr. H. T. Gwyther, from Executive Engineer, 3rd grade, sub. *pro tem.*, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 8th April 1888.

Mr. A. Greenless, from Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 4th grade, temporary rank, with effect from 8th April 1888.

Mr. W. D. Barrow, from Assistant Engineer, 1st grade to Executive Engineer, 4th grade, temporary rank, with effect from 14th April 1888.

Mr. G. Deuchars, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 20th April 1888.

Mr. G. Deuchars, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 7th May 1888.

Mr. G. Deuchars, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 19th May 1888.

Mr. T. Michell, from Executive Engineer, 3rd grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, permanent rank, with effect from 27th May 1888.

Mr. H. J. Oddie, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, permanent rank, with effect from 27th May 1888.

Mr. P. Duncan, from Executive Engineer, 3rd grade to Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 27th May 1888.

Mr. H. T. Gwyther, from Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 27th May 1888.

Mr. A. Greenless, from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 27th May 1888.

Mr. J. B. Chirnside, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 30th May 1888.

Mr. H. E. Haddon, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, permanent rank, with effect from 31st May 1888.

Lieutenant S. L. Craster, R.E., from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, permanent rank, with effect from 31st May 1888.

Mr. J. M. A. Despeissis, from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, permanent rank, with effect from 31st May 1888.

Mr. G. P. Rose, from Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 1st June 1888.

Mr. H. P. Burt, from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 1st June 1888.

G. T. St. A. Nixon, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 18th June 1888.

Mr. A. J. Hughes, Superintending Engineer, 3rd class, temporary rank, Bengal, temporarily employed in the North-Western Provinces and Oudh, is promoted to Superintending Engineer, 2nd class, temporary rank, as a supernumerary.

With reference to Public Works Department Notification, dated 18th June 1888. Mr. J. G. H. Glass is promoted to Superintending Engineer, 3rd class, temporary rank, with effect from the 10th August 1888.

Mr. W. E. T. Bennett, Assistant Engineer, 1st grade, is transferred temporarily to the Accounts Branch in the temporary rank of Deputy Examiner, 2nd grade, and is posted to the Office of the Examiner, Public Works Accounts, Bengal.

#### North-Western Railway.

Mr. C. T. R. Scovell, Assistant Engineer, 2nd grade, attached to the North-Western Railway, Punjab Section, has been granted six months' leave on urgent private affairs to Europe, with effect from the forenoon of the 11th August 1888.

#### Bengal, September 5, 1888.

Adverting to Departmental Notification of the 19th June last, Mr. J. P. Cleghorn is appointed to officiate as Executive Engineer of the Acquapada-Jajepore Division, and Mr. A. Monies to officiate as Executive Engineer of the Brahmini-Byturni Division. Mr. Cleghorn assumed charge of the former Division on the afternoon of the 15th July 1888, and Mr. Monies assumed charge of the latter Division on the forenoon of the 25th July 1888.

Adverting to Departmental Notification, dated the 10th ultimo, Mr. C. H. DeMello, Assistant Engineer, is posted to the Cossye Division.

## Indian Engineering Patent Register.

### RECENT GERMAN PATENTS.

ROTARY ENGINE.—*J. Selwig, Braunschweig, Germany.*—The two accompanying figures represent two sections taken at right angles to each other. The engine consists of three main parts—the crown wheel A, the pinion wheel B, and the casing C. The teeth D of the wheel A are cast in one piece with the cylindrical disc S, which is attached to the driving shaft O. The wheel B turns on the axis P, which forms



Fig. 1.

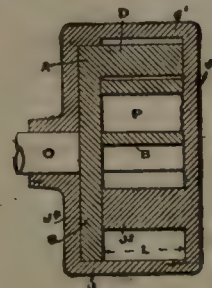


Fig. 2.

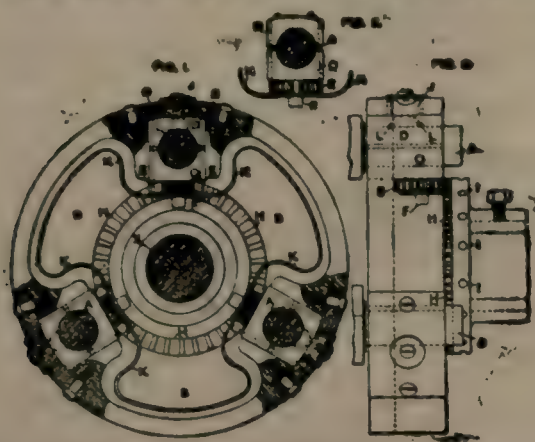
part of the outer casing. The part J<sup>2</sup> of the casing forms a prismatic projection penetrating from the front side part J<sup>1</sup> to the inside of the wheel A. When a liquid under pressure is present at the left hand side of Fig. 1, the wheel B is caused to turn in the direction of the



arrow, carrying with it the wheel A; motion is thus transmitted to the shaft O. The engine can be used for either liquids or gases, and as a pump or blower. Six claims are made for this engine, and for an adaptation.—No. 3801. March 12th, 1888.

#### RECENT BRITISH PATENTS.

**NAP RAISING MACHINES.**—J. Y. Johnson, London. (*G. M. Bauche and H. A. Bauche, Paris.*)—Figs 1 and 2 shew a front and side view of a set of three workers or nap raisers, and Fig. 3 is a detached view of the bearings of a worker. The axis A of each of the workers is mounted in bearings C D: C is capable of sliding in guides in the carrier B. According to the degree of pressure of the spring K on the moveable portion C, the freedom of the shaft A to rotate will be regulated; and as the rotation of the shaft is effected by



the contact of the workers with the material, the action of the workers on the material will be varied by the degree of elasticity of the spring. To regulate its elasticity the moveable part D is provided with a stem F, upon which is screwed the pinion E gearing with the wheel H. By rotating the wheel H the pinion E will be screwed up or down, and the spring will press the moveable part D against the axles A with greater or less power. Each of the parts C of the bearing is held in position by a covering plate G, which is screwed upon the rim of the carrier B, and in this plate there is a chamber J for the reception of lubricating matter. Five claims are made for mounting the workers in flexible or yielding bearings, so arranged as to be capable of being adjusted to vary the pressure of the workers on the material operated on.—No 4102. March 16th 1888.

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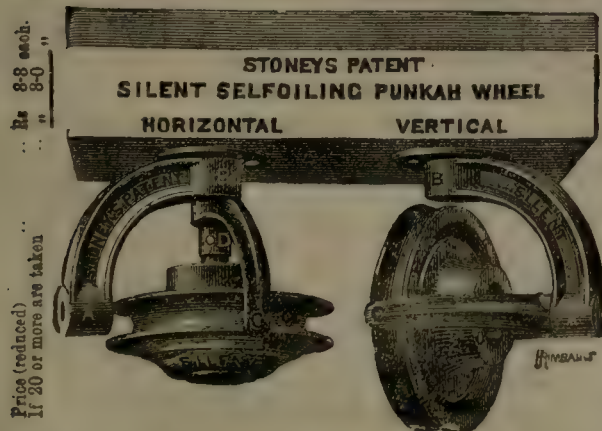
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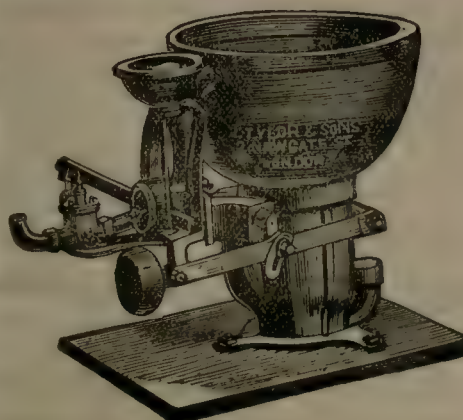
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Re-insurances ...	£769,265 0 0	Re-insurances ...	£125,559 0 0	Re-insurances ...	£175,118 0 0
Interest ...	£ 19,612 0 0	Interest and Dividends ...	£ 45,649 0 0	Interest ...	£ 8,294 0 0
Losses after deducting Re-insurances ...	£443,587 0 0	Claims less Re-insurances, ...	£ 79,229 0 0	Losses after deducting Re-insurances ...	£138,365 0 0
				Interest not belonging to above, but included in Profit and Loss	£ 18,545 0 0

The Life Fund was increased during the year by £265,643 and now amounts to £1,070,064.

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# INDIAN ENGINEERING.

SATURDAY, SEPTEMBER 15, 1888.

## POSITION AND PROSPECTS OF CIVIL ENGINEERS IN THE PUBLIC WORKS DEPARTMENT.

### I.

It is admitted on all sides that the present state of the Public Works Department is one which loudly calls for reform alike in the interests of Government, of the public, and of the officers themselves. A state of things under which such a balance sheet as that for the Punjab during 1887-88, which shews an expenditure of Rs. 9,24,600 on Establishments to a Budget Estimate of Rs. 8,36,400 for original works and Rs. 12,50,000 for repairs, yielding a percentage of 48 on Establishments to works including repairs, or of 110 on new works, needs no comment. And when it is further found that, notwithstanding these and other heavy charges, the whole staff is complaining of ungenerous treatment at the hands of Government, it is clear that something is very seriously wrong in the constitution of the Department, which most urgently calls for a change. The causes of the present well-grounded discontent among Civil Engineers it would be long to trace; suffice it to say, that they are mainly due to the operation of two great causes :—

(1.) The absence of any settled policy in the construction and maintenance of Public Works, and of any regular and systematised forecast of expenditure.

(2.) To the military constitution of the Department, by which men are bound to a despotic routine and deprived alike of interest in, and responsibility for, their work; and under which they have no chance of bringing their grievances and disabilities to the notice of Government.

In view of this disability, a Civil Engineers' Defence Committee was constituted in Calcutta prior to 1876, and memorialized the Government of India on the subject. These temperate statements of grievances admitted by both the Secretary of State and by Lord Mayo, were considered a violation of the discipline, which a military constitution had forced on the Department, and a Government order prohibited all joint memorials. The Defence Committee then turned their hopes to Parliament, and this now seems to be the only tribunal at which they have a chance of being heard.

The number of Civil Engineers in the Department is at present a little under 800, and as to their present position and prospects, they fall roughly into three classes.

(A.) Those who joined the Department prior to 1876, (B) those who joined subsequent to that date, and (C) the Indian College men. A careful analysis shews that the former class, which includes "Stanley" and Cooper's Hill Engineers, and a minority taken on in India, though they have not realized the gorgeous prospects in the promotion list offered by the Government of India for their "guidance" when inviting them to enter the newly founded Cooper's Hill College, have yet obtained fairly good promotion, and most, if not all, of the "Stanley" men have little cause for complaint on this score. But



the men who came out in 1876 and subsequent years, are in very hard case. The bulk of them are still Assistant Engineers, 1st grade, permanent, after, in many cases, as much as twelve years' approved service, and their prospects, even when the 50 years' rule has come into full working, are deplorable. The men who joined from 1876 to 1880, will, under that rule, mostly leave the Department after a tenure of the rank of Executive Engineer, 1st grade, of from 1½ to 4 years, and will make way for their juniors, whose prospects will then be progressively better.

The official prospectus issued by the India Office in 1871 to invite competition for Cooper's Hill, shewed that after a three years' course, appointments of Assistant Engineer, 2nd grade, on Rs. 4,200 per annum, were guaranteed. It also gave the ranks and salaries as follows:—

*Salary per annum.*

Chief Engineer, 1st class	...	...	Rs. 30,000
" " 2nd "	...	...	" 24,000
" " 3rd "	...	...	" 21,600
Superintending Engineer, 1st class	...	...	" 19,200
" " 2nd "	...	...	" 16,200
" " 3rd "	...	...	" 13,200
Executive Engineer, 1st grade	...	...	" 11,000
" " 2nd "	...	...	" 9,600
" " 3rd "	...	...	" 7,800
" " 4th "	...	...	" 6,600
Assistant Engineer, 1st "	...	...	" 5,300
" " 2nd "	...	...	" 4,200

The Secretary of State was also kind enough to add, for the guidance of candidates, that "ten rupees are nearly equivalent in value to £1."

If this table of salaries is examined, it will be seen that in the junior ranks very small increments of pay are given from rank to rank, and it is clear that such a scale of salaries is only applicable to a service where there is a regular and steady flow of promotion. If this is not so, the scale is meaningless in a prospectus inviting men to compete for the service. The earlier Cooper's Hill Engineers state that a tabular statement was given to them "for guidance," shewing the promotions of the past 15 years' and that these worked out to an average service of 2½ years or so in each grade. This would enable an Engineer to reach the 1st grade Executive rank after from 12 to 15 years' service, whence selection by merit, pure and simple, would promote certain men to Superintending Engineer, leaving the rest to retire from the 1st grade rank after a service of 8 years and upwards in the grade. How far these implied promises are from realization may be gathered from the fact that there are now in the P. W. D. about 48 Cooper's Hill Engineers with an average service of nearly 12 years who are only 4th grade Executive Engineers; that there are about 183 Assistant Engineers with an average service of nearly 8 years; that 27 men who came out in 1878 are still Assistant Engineers, 1st grade, with 10 years' service.

There is, therefore, an urgent need for some re-organization of the Department by which a fair flow of pro-

motion may be given to this class, and by which, also, a recurrence of this injustice and hardship may be prevented.

Besides this one point of promotion, however, there are several others in which all Civil Engineers are hardly treated.

So long ago as 1869 the Duke of Argyle, then Secretary of State for India, wrote:—"It cannot fail to conduce to better harmony between the Military and Civil branches of the Establishment, if whatever advantages are accorded to the members of one, on first entry, should be obtained by both.

"I would further wish you to consider whether there ought not to be only one scale of salaries and allowances for all members of the service, both Civil and Military."

This was endorsed the following year by Lord Mayo, who replied to the Secretary of State in the following terms:—

"With reference to para. 4 of your Grace's despatch we may remark that we have already recommended the equalization of the pay of the Military and Civil branches of the Department, and we are gratified to find that Her Majesty's Government are likely to receive that proposal favorably. On this point, we only add, that we shall be glad to see some plan adopted by which the furlough allowances of Civil Engineers shall be equalized with those of Military Officers in the P. W. D., and, so far as practicable, their advantages of pension also."

Notwithstanding this, nothing was done, and the present position and prospects of Civil as compared with that of the Military members of the P. W. D. is shewn in the subjoined table.

ROYAL ENGINEERS.

*Service for pension* is from date of 1st commission including all service on half pay, effective or retired list, at home or elsewhere.

*Three years British service* in addition all leave out of India (however long) counts as service for Indian pension.

Draw in addition to the Civil pay of their rank Military pay as under:—

	Rs. A.
Lt. Rs. per month	70 0
Capt. " " "	140 0
Major " " "	180 0
Lt.-Col. " " "	243 8
Col. " " "	304 6

Draw on furlough a minimum pay of 250 *Pounds sterling* per annum.

CIVIL ENGINEERS.

*Service for pension* counts from date of leaving Cooper's Hill, and includes at most one year's English training.

A maximum of four years only counts for pension out of all leave, including sick leave and furlough during entire service.

Do not draw any additions to their net Civil pay.

Pay on furlough is half pay at current exchange. There is no minimum. Some officers would now after 10 years' service draw £180 a year if sent home sick.



ROYAL ENGINEERS.		CIVIL ENGINEERS.	
Retire on pensions as under:—		Retire on pensions as under:—	
After 20 years' service	£ 250	After 20 years' service	Rs. 4,000*
" 24 " "	£ 365	After 25 years' service	" 5,000*†
" 28 " "	£ 500	No corresponding pension.	
" 32 " "	£ 700	No corresponding pension.	
		<i>All are paid in Rupees.</i>	
		* Equal at present exchange £260 and £333.	
		† Subject to a possible grant of an additional pension of Rs. 2,000 (£133-6-8) and Rs. 1,000 (£66-13-4) for Chief and Superintending Engineers respectively.	

We have taken the prospects of the Cooper's Hill men as being the most favorable. "Stanley" men count their service from date of landing in India, and as some of these came *via* the Cape, six months nearly have to be deducted from the date of their appointments.

The case of the men appointed in India is harder still. Prior to the Government order of 1st April 1876, which for the first time publicly notified that any distinction was contemplated between men appointed in England and in India, they naturally inferred that they would receive the same treatment as others.

They joined the Department before anything was publicly known regarding the change in the rules, and while the hope was fresh in the minds of all that the promises of improvement made by Lord Mayo in Circular No. 84 of 6th October would be carried out, and it was not until the notification dated 1st April 1876, that the men who had entered the P. W. D. through the Indian Colleges between 3rd January 1872 and 1st April 1876, knew that any change was to be made in their position. Most of these men have since been admitted to the better pension rules, but not all.

In addition to this, Military Engineers from the Military Works Department are retained and promoted on the General list of Chief and Superintending Engineers, so that it not unfrequently happens that men are brought in from that branch and placed over the heads of Civil Engineers who have served their whole lives on Railways or Irrigation works, which demand alike high special professional skill and unremitting attention to details.

Lastly, the Civil Engineers have no means whatever of representing their claims to the Government of India. They are voiceless in the Secretariat. They are unrepresented at any council board. Their only chance of making themselves heard is in the Press, and it is small wonder if the peculiar and admitted hardships give rise to a crop of temperate and intemperate letters, against all or any of those whom they think responsible for this state of things, or that they should unite to form "Defence Committees," instead of addressing the Head of the Department, the Public Works Minister, who is specially charged with their interests and is supposed to have at heart the efficiency of the service.

## FEATS OF RAILWAY ENGINEERING.

THE first article in the July issue of *Scribner* is a very readable paper on "Feats of Railway Engineering." There must needs have been difficulties in the way of Railway Engineering in the States if we consider the nature of the country traversed by the 150,000 miles of Railway, and the 300,000 miles of track existent.

Long trestles built of wood, but firmly and strongly held together, are much in use amongst the mountains of Colorado, and are said to be entirely effective for transport of traffic for many years. Bold work is often done in the construction of the line upon a mountain side. On the Oroya and Chimbote Railways in South America galleries have been cut directly into the rock, the cliff overhanging the roads way, and the line has been carried in a horizontal cut, or niche, in the solid wall. At many points it was necessary to suspend the persons making preliminary measurements from the cliff above. The Engineer who looked after this work tells the writer in *Scribner* that the galleries were often from 100 to 400 feet above the base of the cliff and were reached generally from above. Rope ladders were used to great advantage. One 64 feet long and one 106 feet long covered the usual practice, and were sometimes spliced together. When a canon directly crosses the line of the road it has to be spanned by a viaduct. The Verrugas Bridge on the Lima and Oroya Railroad crosses such a ravine, with a small stream running through it. It is at an elevation of nearly 6,000 feet above sea-level in a hill country. It is 575 feet long, in four spans, and is supported by iron towers, the central one of which is 252 feet in height. Construction in this case was effected altogether from above. The necessary material having been collected at the top of the ravine, each separate piece was from thence lowered to its proper, its appointed position, by means of two wire-rope cables suspended across the gulf from temporary towers built at either end of the works. On the same line (the Oroya) a tunnel reaches a narrow gorge, a truss is thrown across, and the tunnel continued as if no slightest interruption had ever been.

We must quote Mr. Graham Tomson about the location of the Mexican Central Railway, through the cut of Nochistongo. He writes:—Far underneath the level of this line of Railway there was skilfully constructed, in 1608, a tunnel which at that period was a very bold piece of Engineering. It was designed to drain the Valley of Mexico, which has no natural outlet. This tunnel was more than six miles long and ten feet wide. It was driven through the formation called *tepetate*, a peculiar earth with strata of sand and marl. It was finished in eleven months. At first excavated without a lining, it was afterward faced with masonry. It was not entirely protected when a great flood came, the dikes above gave way, and the tunnel became obstructed. The City of Mexico was flooded, and it was decided that, instead of repairing the tunnel, an open cut should be made. The Engineer who had constructed the tunnel, Enrico Martinez, was put in



charge of this enormous undertaking, and others took his place after his death. The cut is believed to be the largest ever made in the world. For more than a century the work was continued. Its greatest depth is now 200 feet. It was cut deeper, but has partially filled with the washings from the slopes. The cost was enormous, more than 6,000,000 dollars in silver having been actually disbursed! Wages for workmen were then from 9 to 12 cents a day. All convicts sentenced to hard labor were put at work in the great cut. The loss of life was very great. Writers of the time state that more than 100,000 Indians perished while engaged in the work.

Early American Railway Engineers, when they had to deal with a grade too steep for their locomotives' traction, used the inclined planes. These were worked by stationary engines, acting upon cables attached to the cars. These cables passed around drums at the head of the planes, the weight of the cars on one track partially balancing those on the other.

When the Niagara Suspension Bridge was building, Robert Stephen said to the designer, the late John A. Roebling, "If your Bridge succeeds, mine is a magnificent blunder." The Niagara Bridge has succeeded. So has the great Suspension Bridge between New York and Brooklyn, with a clear span of 1,595½ feet.

Space precludes us from saying anything more except that we wish Anglo-Indians and Indians took as much interest in Railway subjects as their American cousins and well wishers.

#### THE BOMBAY P. W. D.

MR. JOHN HART, who was at the head of the list of officers in the P. W. D., Bombay, having retired, the long-suffering and slowly-promoted men of the Department naturally look for a step—but rumor says it will not be given, as H. E., the eccentric Governor, is awaiting the decision of the Secretary of State, or some one (who would probably be surprised to hear it) on the question of the re-organisation of the Bombay P. W. Department, as he lately waited, about 10 months, before giving the last steps to Mr. Doig, &c. Will H. E. not be induced to reflect that as long as the Department is on its present footing, the officers belonging to it are entitled to all (and they are not many) the privileges that its constitution allows? Surely this is the fair and reasonable view to be taken of the matter.

It is further rumored that a R. E., lately promoted to the rank of Superintending Engineer, got this step (over the head of a Senior R. E. be it noted) because the Government of India objected to have the former any longer on Defences, to which he had been transferred lately. That is, the former is rewarded for not knowing his own work, and the latter is pushed out of the way to make room for him.

Another rumor is that a gallant R. E., a Superintending Engineer, has taken furlough, which he is spending in Poona, rather than serve under the present régime. The Department must be in a desperate state if such desperate measures are necessary.

#### Notes and Comments.

**BURMA STATE RAILWAY.**—We learn that the Government of India have under consideration a proposal for provincialising the superior Railway Revenue Establishment in Burma, with a view to reduce expenses.

**THE AHMEDABAD MUNICIPALITY.**—The five per cent. loan of Rs. 4,00,000, required by the Ahmedabad Municipality for water-works, &c., has been wholly taken up locally at an average premium rate of Rs. 2-6-3.

**THE DIAMOND FIELDS COMPANY.**—The Madras Presidency Diamond Fields Company, on an experimental washing with hand washing apparatus, has found four diamonds. The permanent washing machinery with the Chief Engineer was to leave England early this month.

**THE "BEZWADA EXTENSION RAILWAY."**—We learn that the remaining 45 miles of H. H. the Nizam's State Railway from Bonakulu to Bezwada is expected to be completed by the middle of next month, the only heavy piece of work now remaining to be constructed being the Uyra Bridge.

**RIPON HOSPITAL, SIMLA.**—It is said the Ripon Hospital, Simla, is to be re-roofed with corrugated iron sheeting, as the present covering of tiles is leaking somewhat badly. As the building is of red brick and brown painted timber, the new grey roof will contrast pleasantly with the warmer colors.

**THE BENIGHTED (?) PRESIDENCY!**—Madras has instituted Higher Examinations of a special character in Science, Art and Industries. The subjects are drawing, painting and design, pottery and porcelain manufacture, book-keeping, phonography and business correspondence and transactions.

**MADRAS TRAMWAYS.**—The Syndicate that secured the concession for the Madras tramways has formed a Company, and sent a draft order for the rolling-stock and rails for approval. This has been accepted by the Municipal Commissioners, who, however, have resolved that the capital must be £120,000.

**IRRIGATION IN WESTERN INDIA.**—A report by the Public Works Department shews that during 1887-88 the total irrigated area in the Bombay Presidency was 44,303 acres, and that the water-rate assessments amounted to Rs. 2,10,424. This was an increase over the previous year of 3,400 acres and Rs. 31,599 respectively.

**BENGAL-NAGPUR RAILWAY.**—It is expected that the line from Asansol to Purulia will be ready for traffic early next year, and arrangements have been already made for the working of this section by the E. I. R. for a period of three years, by which time the Damuda will be bridged, and through communication open to Nagpur.

**SCIENTIFIC RESEARCH WITHOUT BOTHER!**—Wanted, by the Council of the Royal Meteorological Society, photographs of lightning flashes. A rapid plate and a rapid lens left uncovered at night when a thunderstorm is on the tapis will, it is said, do the business without any bother to the—operator: he must be called, we presume.

**P. W. D., BURMA.**—It is rumored that Mr. H. F. White, Superintending Engineer, 1st Circle, Burma, is likely to go on privilege leave about the end of October, and that Mr. Ring, who will return from furlough about that time, will officiate for him. We believe that the Chief Engineer and Chief Commissioner are at one in respect to the necessity of a Superintendent of Works for Upper Burma.



**NEW VICEREGAL LODGE, SIMLA.**—Some are of opinion that the effect of the electric light in the ball-room at the new Viceregal Lodge is simply ghastly. Others consider the soft drapings tone down the glare of the white and gold coloring quite sufficiently. The upper part of the house is usually left in darkness when the lower is fully lighted, as the batteries are not strong enough to light up the whole brilliantly at once.

**OUR DEFENCES.**—The war scare is spreading, and plans are being prepared for construction of a dock at Bombay to accommodate first-class ironclads. That is a very pretty arrangement, and will, of course, commend itself to the Indian tax-payer. But, where are the first-class ironclads to come from? The Admiralty can't supply sufficiency of vessels for channel defence even. What hope is there then for such an unconsidered trifle as Bombay.

**A RAILWAY SERVICE CORPS.**—Colonel Conway-Gordon, R.E., has incepted a scheme for formation of a Railway Service Corps, which is to combine the advantages of Volunteer military service with the peculiar requirements of a Railway in time of war. A scheme that must needs commend itself to popular regard on prudential considerations, and that is capable of serviceable utilization in many ways so manifest, that they need not be detailed here.

**PROGRESS OF COTTON MILLS IN INDIA.**—On the 30th June there were in all India 114 cotton mills working and in course of erection, containing 2,488,851 spindles, and 19,496 looms; employing on an average 82,369 hands daily; and consuming, approximately, 787,000 bales of cotton (of 392lbs. each) in a year. There has thus been an increase of 11 in the number of cotton mills during the past year; while since 1879 they have more than doubled.

**TIN-MINING IN BURMA.**—The British Government appears to have done little or nothing to develop the stanniferous deposits of Mergui, for we learn that block-tin to the value of only Rs. 43,213 was shipped in 1887-88 chiefly from Mergui to the Straits. Although the value in the previous year was Rs. 17,878, still we think that as compared with the enormous outturn of the Native States of the Malay Peninsula the result must be considered as nothing.

**BURMAN TEAK TRADE IN 1887-88.**—There has been but little improvement in the price of teak generally, but the demand was brisker for Europe and Ceylon, and the quantity shipped in the year under review shews an increase of 62.94 per cent. over the year immediately preceding, although it is not equal to the exports of each of the three previous years. Egypt appears to be a large consumer of the Burma wood, standing almost on a par with Ceylon in that respect.

**CALCUTTA UNIVERSITY.**—The following change in the Regulations for the Entrance Examination of the University has been sanctioned by the Senate and approved by His Excellency the Governor-General in Council. *Drawing.*—An optional examination shall be held in drawing. If a candidate passes, the fact shall be notified in his certificate; but success or failure in that subject shall not affect his success or failure in the Entrance Examination or his position in the pass list.—*Cui bono?*

**DOCKYARDS IN THE EAST.**—The Select Committee of the House of Commons on the Navy Estimates elicited the information that if, in the event of a war breaking out, and three line-of-battle ships were badly knocked about, the dockyards at Hong-Kong, supplemented by the private yard, would be competent to deal with them; and that the dockyards at Bombay and Calcutta were

not capable of taking large ships. Vessels drawing 17 feet of water would be the largest that could enter the docks at those places.

**OUR ONLY MOUNTAIN RAILWAY.**—The Darjeeling Railway is a distinguished triumph of Indian Engineering Art. But is not the management drifting into a fashion of complacently tolerating too many mishaps and failures? Some are, of course, inevitable on a mountain line in the rainy season. But it seems to us that chance has been allowed more than a fair share in the conduct of the Darjeeling-Himalayan Railway of late; and we deem that the time has come for better, more painstaking control.

**"PATRONISING—VERY!"**—The *Poona Observer* says that:—"The *Pioneer* can afford to be patronising when it likes;" and after quoting the remarks of the Allahabad paper *re* "Ourselves," it adds:—"Whether it is Sir Charles Elliot, or the Viceroy, who is to blame, there can be no two opinions that Mr. Pat. Doyle, the Proprietor and Editor of **INDIAN ENGINEERING**, has been most unjustly dealt with. It is satisfactory to find that the majority, and the more independent journals in India, have supported Mr. Doyle."

**ALLAHABAD WATER-SUPPLY.**—Mr. Hughes estimates that the provision of a twenty-gallon supply for 120,000 persons, with a full complement of pipes for a 25-gallon supply is estimated to cost Rs. 17,97,598, with Rs. 2,04,439 for maintenance; a ten-gallon supply, and a full complement of pipes will cost Rs. 14,01,598, with Rs. 1,46,673 for maintenance, and a twenty-gallon supply and full complement of pipes, the coal and working charges, however, regarded as for a ten-gallon supply, will cost Rs. 17,97,598, with Rs. 1,74,393 for maintenance.

**A TOPIC FOR THE RAILWAY CONFERENCE.**—An up-country paper forecasting the possibilities and probabilities of the coming Railway Conference, pertinently refers to lack of provision of drinking water for passengers—especially in the hot weather—as a "terrible affliction." So it is *Experto crede*. Our contemporary writes:—"The menial servants maintained for the express purpose of supplying the wants of thirsty and hot travellers might well be kept to their legitimate work, and be prevented from being used as the personal and domestic attendants of Station Masters." We concur.

**A PLEA FOR THE EAST COAST RAILWAY.**—One of the reasons adduced in support of Mr. Turner's proposal for a Railway through the Northern Districts of the Madras Presidency is the difficulty, and often impossibility, of intercommunication between ships and shore, owing to the absence of harbours. At present, it appears, if you want to land or embark at one of the 'Northern Ports,' you must either choose your season of the year, or take your chance of a ducking or drowning, or being carried on beyond your destination. A Railway would not present this choice of alternatives.

**POONA CANTONMENT DRAINAGE.**—There are fifteen miles of open concrete drains for the discharge of sullage from houses. These are flushed daily, morning and evening, and the contents are discharged into some of the covered sewers, which having been built many years ago are defective. They are square at the bottom, instead of oval. The matter has been taken up, plans and estimates submitted and in a short time these defective sewers will be reconstructed according to modern developments with a proper gradient, so as to admit of free discharge, and not likely to catch any organic matter.



**THE POST OF DIRECTOR GENERAL OF TELEGRAPHS.**—A Calcutta paper observes that it is very probable that Colonel Mallock will be confirmed in the post of Director-General of Telegraphs, and will be granted an extension of service after April next, when, in the ordinary course, he would retire under the 55 years' rule. Colonel Mallock is an able officer, who has done excellent service, and India would be the loser by his going. In that contingency, the Government would probably have to choose between Mr. J. H. Lane and Mr. W. R. Brooke. There is no doubt about Sir Albert Cappel's intention not to return to India.

**THE OUDH AND ROHILKHAND RAILWAY TRANSFER.**—The *Civil and Military Gazette* says that as speculation is still rife as to the probability of the amalgamation of the Oudh and Rohilkhand Railway with the North-Western, it may state that the matter is settled for the time. There will be no amalgamation at present, at any rate. But the *Morning Post* asserts that it is not unlikely that when the Oudh and Rohilkhand Railway is taken over by the State, Colonel Dowden will be appointed Manager of the North-Western line, Colonel Conway-Gordon being confirmed in the appointment of Director-General.

**ALLAHABAD WATER-SUPPLY.**—The Water-Works Subcommittee of the Allahabad Municipality have decided that they are unable to consider the preliminary project submitted to them for a water-supply by the supervising Engineer until it has been decided by a special meeting of the Commissioners, whether they will comply with the request of Government to place the loan in the open market. The original application of the Commissioners was that the money might be advanced at 4 per cent.; and the reply of Government practically is that until it has been ascertained to what extent the Commissioners are able to help themselves, no special assistance can be given them.

**THE INDIAN MIDLAND RAILWAY.**—This line is rapidly approaching completion. On the main line platelaying is proceeding from both the Jhansi and Bhopal ends, and they expect to link on (I think that is the correct expression) in about six weeks' time, and by the end of October we shall probably have two construction trains running daily through from Bhopal to bring up the iron work, &c., for the Jhansi Station buildings, work on which was commenced last week. All the bridges on the Jhansi-Gwalior section are finished, and they will commence platelaying as soon as there is through communication with Bhopal. This length should be completed by the end of the year.

**GRAVING DOCK FOR COLOMBO.**—On 17th February Government intimated to the Colombo Chamber of Commerce that a despatch had been received from the Secretary of State that the existence of a Graving Dock at Colombo, capable of accommodating Her Majesty's ships, is not, in the opinion of the Lords of the Admiralty, of sufficient importance, so far as the interests of the Navy are concerned, to warrant them in making any proposal in respect of the provision of funds towards its construction. It is hoped, however, that the question may be re-opened, or, failing this, that Government will facilitate the formation of a private Company for the providing of a Dock.

**WEST INDIA SUGAR TRADE.**—Owing to depression in the sugar trade Demarara and Trinidad planters requisitioned India for only 4,625 coolies last year. The year

before they wanted 7,010. The export duties on sugar and rum were reduced from Rs. 5-9 and Rs. 4-6 respectively, to Rs. 3 per hogshead, and Rs. 2-6 per puncheon—a reduction which is said to have greatly relieved the planting industry. Planters had contented themselves with a smaller acreage under cultivation than had sufficed for their ambition in previous years; they worked scientifically and economically, and they had their reward; for the crop yield was good, and exports of sugar and rum did not fall short of those of previous years.

**CHANGES IN THE BENGAL P. W. D.**—From the last *Calcutta Gazette* we learn that Mr. J. D. Davies has been appointed Executive Engineer in the 2nd Calcutta Division in succession to Mr. B. K. Finimore, proceeding to Khatmandu. This Division, which might fairly be considered the most important Public Works charge in Bengal has been held by five Executives since the 1st of January this year: these changes can hardly conduce to a thorough performance of duties, both arduous and important, and must be a source of annoyance to the heads of Departments, who have to deal with the Executive Engineer in charge of their buildings. The works in progress, too, cannot be said to benefit by these frequently recurring changes.

**C. E. DEFENCE COMMITTEE.**—We learn that the C. E's. of the P. W. D. are again astir, and that they do not mean to let the grass grow under their feet. There are several grievances still remaining to be cleared up and not the least of these is the question of pensions at a fixed rate of exchange. One of the points which in some unaccountable way has not been sufficiently pressed, is the uniformity of the Civil element in the Department; so long as there are degrees and factions in this body, so long is there excuse for a Military faction under its special rules and privileges. There ought to be a strong local Committee in each province, and the local Secretary should be a man not only who is willing to devote himself to the cause, but who is bound up in the province, is to an extent stationary, and who is both looked to and trusted.

**TIN-MINING IN BURMA.**—We learn that "Mr. Hughes of the Geological Survey, will proceed forthwith to Batavia to inspect and report upon the successful methods by which Engineers from the Netherlands work the tin-mines of that productive region. The ultimate object in view is to utilise in Tennasserim the experience acquired in the Dutch Indies. There is an abundance of valuable tin ore in Tennasserim and the adjacent regions, which needs only to be profitably worked to yield satisfactory returns." This information is deceptive. The mines referred to are in the islands of Banca and Bileton; but Mr. Hughes need not go so far. He would find all the information he wants in the British Protected States of the Malay Peninsula, the most important mines of which are described in Doyle's *Tin-Mining in Larut*.

**"GONE OVER TO THE MAJORITY."**—A Correspondent writes:—The well-known, everywhere known, popular E. I. R. mail train driver, Mr. John Wemys,—"old Johnnie"—died the other day at the Calcutta General Hospital. He joined the Company thirty years ago as a fireman, and by dint of sobriety and attention to his duties, soon rose to the position of driver. At the time of his death he had been for over twenty years employed in running mail trains. Mr. Alfred Collier, another popular driver, has also gone over to the majority—with dropsy. Just before his death he officiated as Locomotive Foreman at Toondla Junction. Mr. H. H.



Haynes, who joined the Company in 1871, and was time-keeper in the Allahabad Shops, succumbed to heart disease on the 24th ultimo. King Death has been unkind than usual this autumn.

**MANDALAY RAILWAY EXTENSION.**—It may be taken for granted that the line to Mandalay will not be open on 1st January 1889 and that this event will not take place till about next March. The delay is due to the inability to complete the Sinthay bridge (22 miles North of Pyin-mana) for want of girders, &c., in the 3rd division, and three or four other bridges in the 6th division. The Railway Engineers, especially in the 3rd and 4th divisions, have had indescribably heavy work. Such a season's work in fact has never been dreamed of in Burma before; but the fates have been against them in every way that was possible. First came famine, then pestilence, hundreds of the workmen dying from cholera, and then most unseasonable floods, all which caused a delay of two months and finally the breakdown of communications at Sinthay for the cause already explained.

**THE "TANSA" SCHEME, BOMBAY.**—We glean that the works on the whole are now progressing with much greater rapidity than was possible before all the pneumatic machines had been put up. Owing to the delay from sickness amongst the staff and the workpeople and from other causes the progress made has not as yet come up to Mr. Clerke's yearly forecast. But that forecast allows a year's margin, and it is now growing evident that this will not be required; Messrs. Lovett and Walsh may even still hope to obtain the bonus for finishing within the contract time. A good deal of the iron work has arrived for the bridges. The great dam is progressing more rapidly. The delay occasioned by having to go deeper in some places for the foundations than the trial pits seemed to indicate has now been made up, for the aqueduct will probably be finished in 1891, while the dam will be completed in 1892.

**A CORNER IN COAL.**—The *Times of India* says:—This market is in a very strong position. There is no unsold coal on the way to Bombay, and only two or three cargoes already disposed of. Outward freights have advanced owing to the steady demand for other ports. Powell's Duffryn has advanced 1s. a ton in England, making the cost alongside in Bombay harbour Rs. 26 per ton. Re-sales have been made here at Rs. 23½ to Rs. 24½, and now Rs. 25 is asked. To add to the firmness a strike in Australian Collieries is announced, and coaling stations usually taking their supplies from the Colonies are now indenting on the mother-country. Consumers in Bombay must, therefore, fall back on Bunder Stocks, and these are moderate and limited. Holders are in a very strong position; and, as far as can at present be judged, there will be full rates current for some months, if not an actual corner in October.

**UPPER BURMA PUBLIC WORKS.**—The works in our newly acquired territory are so scattered, while very heavy outlay is incurred on them, that it is hardly possible that they can be well supervised by two Superintending Engineers in an efficient manner, nor can check be well exercised on unprofitable and bad work, and it would be true economy in the end to have an extra inspecting officer, who may be either a Superintending Engineer or Superintendent of Works well acquainted with the country and its resources. It is rumoured that when Mr. King returns from furlough, he will be made a Superintending Engineer for Burma, and Mr. Richard, who is at present

officiating in that capacity, will have to revert to the charge of a division. This would be a great pity, but we trust the Government of India may see its way to retain Mr. Richard's services in Upper Burma, if not as a Superintending Engineer, at least as a Superintendent of Works, in which capacity he served under Major Gracey, R.E.

**INDIAN MANUFACTURES.**—That the future history of India will deal largely with its developments as a manufacturing country we feel assured, and the wealth which might be developed is enormous, but the people must be educated up to the point of full development before much can be done. For it is in Indian manufacturing industries, to the development of native skill that we must look for final success. No amount of imported skill can do anything without that, for the influence of a European foreman over his workmen, though often very considerable, is only that of a master to be obeyed, and not that of a leader to be trusted. The native workman sees that the methods followed by his English instructor produce good results, and he occasionally follows those methods, but if any detail appears to him to be of more trouble than it is worth, he simply ignores it and considers that the "Sahib is a little mad on that point," and consequently often loses much that is essential to the work in hand.

**FORTIFIED RAILWAY CENTRES.**—Sir Samuel Baker, discoursing on the insecurity and fallibility of existent Indian institutions, falls foul of Jubbulpore. That great station, the key to the Railway system of Central India, is, he avers, like all other Indian Railway centres, unfortified and at the mercy of an enemy. But he forgets that this suppositious enemy of his imagining has got to get there before the danger can be developed, and the betting we take it, offers long odds against such a possibility. As the *Bombay Gazette* pertinently suggests, "in what country in the world are Railway stations in the interior fortified and garrisoned. From a military point of view it would be a source of weakness to have to occupy so many forts." In 1857, in the Mutiny time, Railway Engineers, although quite unprepared for the *émeute*, made a notable, most ingeniously contrived, and eminently successful defence of such places. And so they would again, if like necessity arose. Fortified Railway centres would prove sources of weakness rather than of strength in an emergency.

**THE QUESTION OF RAILWAY EXTENSION IN KASHMIR.**—The Sialkot-Jammu line, about 25 miles in length, which is now under construction on the broad gauge, will not really open out the country. There are three projects to be considered. First, an extension from Jammu to Islamabad, a mountain line on the metre gauge. This would be very costly. Secondly, a line starting from below Mandla, 30 miles south of Rawal Pindi on the North-Western line, and running to Jhelum below Kohala, whence it would be carried onwards to Baramulla. This line would follow the new cart road into Kashmir for the greater part of its length, and the estimated cost is 2½ crores of rupees. The third suggested line would take off at Kalaka-Sarai, on the main Railway system, and run northwards through Haripur and Abbottabad to Mansehra. Thence it would turn due eastwards, and entering Kashmir at Mozufferabad would follow the Jhelum Valley to Baramulla. The cost of this line would be slightly less than 2½ crores. The last project may recommend itself to the Government of India from the fact that it would possess considerable strategic value, as facilitating control of the Hazara frontier.



## Current News.

CAPTAIN H. BARNETT, R.E., has been transferred from Jhansi to Ferozepur.

THERE is fear of a famine in Hyderabad, the rainfall up to date having been very scanty.

THOUGH the number of minor accidents on Railways is greater in India than in England, the casualties are fewer.

A SECOND attempt to start a steam laundry has proved a failure, owing to the dearness of skilled labor, and the want of adequate patronage.

ON the Kashmir Railway it is intended that there shall be six stations between Sialkot and Jammu, including the Sialkot Cantonment station.

MR. J. A. JONES, Vice-President, Public Works Department of the Madras Municipality, who has obtained a year's furlough left for London last week.

A SECTION of the Bengal Sappers and Miners, under the command of Captain Stanton, Royal Engineers, proceeds from Roorkee at once to Gnatong.

THE Delhi Industrial School of Arts, which has been in existence for five and a half years, has been closed, and the stock in hand disposed of by public auction.

DR. RIBBENTROP has returned to Simla after settling the difficulties between the Government and the Bombay-Burma Trading Company in regard to the leasing of the Upper Burma forests.

THE Railway from Nagpur to Raipur is to be opened next month, and early next year it is hoped that 65 miles additional, to Bilaspur, will be ready, and perhaps yet another 50 miles at the Bengal end.

TWO Sub-Committees have been formed by the Railway Conference, one to consider the rules for the working of the Railways under construction, and the other for the revision of the 'standard dimensions.'

THE Director-General of the Archaeological Survey of India, Dr. Burgess—one of the privileges of whose appointment is to spend a portion of every year on duty in England—returns to his post in India this month.

COLONEL BERESFORD LOVETT goes with the Black Mountain Expedition as Commanding R. E., with Captains E. Grant and H. E. Abbott as Field Engineers, and Lieutenants Chesney and MacLagan as Assistant Field Engineers.

THE total number of locomotives employed upon Indian Railways in 1887-88 was 3,364; of coaching vehicles, 8,825; and of other vehicles, 61,219; which ran 45,779,096 train-miles, or an average of 337,010 train-miles per open mile.

NO more explicit official information has yet been received in India regarding the Umballa-Kalka-Simla Railway, than the original telegrams, that a company, of which Mr. Duff Bruce is the chief promoter, had been granted a concession for a line from Delhi to Umballa.

THE Rajputana desert survey party will consist of Mr. Horace Bell, Superintendent Engineer; Mr. F. L. Dibblee, Hazaribagh, and Mr. G. F. Lamb, North-Western Railway, Executive Engineers; and Mr. E. H. Tuck, Sind-Punjab Railway, Assistant Engineer.

SANCTION has been accorded to the commencement of the extension of the Sialkot Branch of the North-Western Railway to Jammu. The total length of the line is 24½ miles, estimated to cost Rs 12,51,616 without rolling-stock, the funds to be provided by the Kashmir Durbar.

THE bridge over the Myitnge Creek, Mandalay Extension, has been completed, and trucks are now running over it. This part of the line will, therefore, be soon ready for traffic. Beyond Myobingyee, however, the embankment has been washed away, and a little distance from Kyoukse the line is a perfect wreck.

MR. J. C. LARMINE, Executive Engineer, Madras P. W. D., who, at the request of Government, cancelled a portion of his furlough to Europe, and returned to India, has been selected to prepare the details for carrying out the scheme for the water-supply of Bangalore, for which Mr. Standish Lee obtained the prize.

THE Consulting Architect, Madras, has obtained the approval of Government to plans and estimates amounting to Rs 63,154, of the Hospital for Caste and Goshia Women, proposed to be constructed at Chepak. Mr. Brassington trusts that the buildings will be completed within ten months from the date of commencement.

PRELIMINARY surveys have been prepared for the Palghat-Dindigul, Porto-Novo-Salem, Madura-Pamban and Mayaveram-Mutupet projects. As soon as the Local Authorities Loan Bill has received the assent of the Governor-General arrangements will be made for preparing a working survey and estimate for the construction of the last-named line.

## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

## CONCRETE ARCHES.

SIR,—The following appears in the *Builder* of 21st July in Notes on a Concrete Bridge near Erbach:—"The arch has a width of 95 feet in the clear by a rise of 13 feet. The vault has a thickness of 1' 7½" at the crown, 2' 3½" at the commencement of the springing of the arch, and of 4' 11" lower down" (the italics are mine). The concrete is composed of 1 part Portland cement, 1 part sand and 3 parts screened Danube gravel (walnut size) and "is rammed in layers 2' 7½" wide." I am in doubt as to whether "width" means "span;" if so, the rise of 13 in 95 or less than ¼th appears very flat for a concrete arch. Also where is the "commencement of the springing" and "lower down." Why should layers be 2' 7½" wide (note the ½ inch), and is this width radial or horizontal? I have built a good many concrete arches with ordinary kunker lime (hydraulic), which usually have the thickness here given for spans about 20 feet; of course, this example is of Portland cement, which is a different matter, but 1' 7½" only at crown for a span of 95 feet appears very small. Would any of your numerous readers criticise this design and give any examples of concrete arches constructed in this country?

September 1, 1888.

KUNKER.

## MOORE'S METRE GAUGE METAL SLEEPER.

SIR,—I note with pleasure the very ingenious metal sleeper, shown in your issue of 1st instant invented by Mr. G. E. Moore. It seems to possess a maximum of advantages with a minimum of disadvantages. The great advantage seems to me to be that there are no rail fasteners to get loose. Once the rails are got in they need not be touched until either the rail or sleeper is worn out or damaged. I am not quite in accord with Mr. Moore as regards the turned down edges. It would be perhaps better to have them flat considering the sleepers have to be slewed into place. If the ballast is well consolidated it should not be knocked out on the opposite side to the beater. The only plan where ribs or bent edges would be necessary is in a transverse direction to give the sleepers a grip on the ballast across the line and prevent it from getting out of the straight. I don't see why the sleeper should be designed only for the metre gauge and be of cast iron. It could be easily adapted to any other gauge and would be better if pressed out of steel plates as then derailments should have but a very slight effect in damaging the metal.

W. R. H.

2nd September 1888.

## CHOICE AND CHANCE.

SIR,—Some *blasé* clubman who has exhausted the resources of whist as hitherto played, or who is, it may be, intolerant of Mr. Proctor's Heathen Chinese dodges of "signalling," and "echoing," and so forth, has invented what is called duplicate whist. Here is the concise rule for playing the new game:—

"Having dealt the cards as usual you play them according to the existing rules; but when the game is over, instead of dealing the cards afresh the same hands which have just been played are again taken by the four players; A and C however having the cards which B and D held, whilst B and D take the hands just played by A and C. Thus the same hands are played out a second time, and score is kept so that it may be seen which pair of partners has made the most of the cards they have successively held."

This process being repeated with every game the rubber is finally won, it is held, by the players who have shewn most skill. Supporters of the new departure claim it as an advantage, a merit that the element of chance is by its means eliminated, the game rendered more scientific. A questionable advantage I take it. The great charm of whist seems to me to lie in its happy combination of the elements of skill and chance, in ability to diagnose readily a strange partner's character, and the likelihoods of his play, in prompt decision consequently as to one's own play. Exercise of this sort of thought reading, plans as to the disposition of a green table campaign in accord with it, all the pleasures and honors and glories pertaining to the conduct of such a campaign, are swept away by duplicate whist. There is no more human interest left in it than there is in a game of dominoes. There seems to me absolutely nothing to recommend duplicate whist to lovers of the grand old game. *Cavendish*, and other experts are said, however, to be strongly in favor of the innovation. And men are fond of, are taken with, a novelty, merely because it is a novelty. So it is likely enough that duplicate whist will prevail, and become the fashion. And so, good-bye to one of the comforts we have always looked forward to as a solace for the witherings of old age.

By the way, Mr. Proctor not long ago contributed to the *National Review* on the "certainties of chance." Like Mrs.



Battle, we have no patience with such men—or rather such ideas. Would life be worth living for most of us but for its uncertainties, its chances? They are the golden hopes which, although they may never reach fulfilment, yet make existence tolerable. Mr. Proctor is as fond of a paradox as the late Professor DeMorgan used to be, and he has faculty for wrapping one up in such "a power of words" that his real meaning is often hard to disentangle. In his *Review* article, after proving arithmetically that there is no such element as luck in gambling, he admits that popular belief in luck's running even is true in a sense, but withal misleading. So is he, I take it.

"HOYLE."

#### PROFESSIONAL PAPERS ON INDIAN ENGINEERING.

SIR,—I have read S. P. Q. R.'s letter in your last number which is to all intents and purposes a repetition of what was advocated by himself last year in your journal.

It is passing strange that we should be kept so much in the dark as to what is being done in every Province in India. I do not know what it would cost to bring out an Album with a letter press description of the various works which are now to be seen on all our Trunk Railways. The subscription to your journal is absurdly low, and I for my part would not grudge double the amount if you could see your way to giving effect to S. P. Q. R.'s suggestions. Such a work would be one of infinite value. Our Yankee friends boast that they can bore with a bigger auger than we use—*ex gratia*, their 80 ton Locomotives which are to take goods and mixed trains 60 miles an hour, or their large Cantilever Bridges; but I think on the whole if we take our Indian Bridges—Jhelam, Chenab, Satlaj, Jumna, Sone, Ganges, Hooghly, Chambul, Narbudda, Gandak, Taptee, Kishna, and others too numerous to mention—we can show in this country a record not to be easily beaten,—to say nothing of our Canals—Ganges, Upper and Lower, Sirhind, Bari Doab, Eastern and Western Jumna, Sone, &c. Yet notwithstanding all this how little do even Engineers in India know of what is doing or has been done outside their own Divisions or Districts!

I certainly agree with S. P. Q. R. that by an appeal to your subscribers you might do for India what Humber did for England some years ago.

Your actual subscribers are I believe about 1,000. We pay the very moderate sum of Rs. 12 per annum. Suppose out of these 1,000 you got 500 men to consent to an extra charge of Rs. 10 per annum. Rs. 5,000 would, I suppose enable you to undertake the preparation of plans and statements of some 35 to 40 works of magnitude during one year; and given this amount of support your journal could find a sale in England and perhaps the Colonies and America. I may be considerably out in my calculation, but I think if the plan is feasible you would confer a great boon on Engineers all over India.

C. S. F.

#### ART IN INDIA.

I.

SIR,—It is a current saying that the natives of India have not the genius necessary to make artists; that they are imitators, but not creators; and that it is idle to suppose that the Schools of Arts of Calcutta, Bombay or Madras will ever enable young Hindus to develop themselves into artists.

But to this there is a reason predominating; it is not the lack of genius endowed in some Indians, as could be seen by the works of several of them, in painting for instance; but we could venture to say that to the want of occasions to compare to the need of opportunities for studying the work of old and modern masters, should be attributed the deficiency of artistic productions in India.

When we consider and study the Indian architecture, for instance, we come to the conclusion, that the people who arrived at planning and executing such wonderful systems of architectural buildings must be a people with an artistic genius; this genius may be latent, and require only an occasion to shew itself.

In support of such theory, I am glad to send you the following notes from a pupil of the Madras School of Arts, who is now an artist in Paris, and who, if I am not mistaken, has sent a picture for the Salon of 1888. These notes may be useful to Indian artists; they are dated from Paris, and run as follows:—

It is five years since I came to this place (Paris) with the purpose of gaining more knowledge in the artistic line, and I was able to take to it seriously when I came to Paris, after studying four or five years at the Madras School of Art under the direction of Mr. Chisholm. I gained there all I could, and a diploma, and though I might have continued in that town as a mere drawing master, I felt how much there was still to learn before I was competent to teach the art of drawing, which many think, under a false idea, a very easy task.

I had heard of the great masters of old who had passed away and of those of the present days. My ambition was not satisfied, and I thought it would be a pity to have my young days wasted in a place where art was a dead letter, and where I could get no further knowledge of art.

At last I decided to start for Europe, and I did well.

In France, where I went, everyone, particularly in Paris, like to help a young artist in making his way as easily as possible. As for education in the artistic line, there is every facility; the Government Schools are all free. With a letter of introduction from your Ambassador, the doors of all the schools, libraries and museums are open to you, and there is not the slightest distinction made between Frenchmen or foreigners. I will say that, for my own part, I was well received everywhere, and found every facility in entering the "Ecole des beaux arts" at Paris as a pupil, but of course I had to undergo some examinations, which are obligatory before entering the school.

The principal test is to shew that one is well acquainted with the drawing of the figure (of an academy); besides you are questioned in general history, anatomy, perspective, and a little on architecture and modelling; then you enter one of the three studios of the best masters of the day for teaching pupils. These masters are appointed for life; each take up one of the classes and receive a salary of 8,000 francs yearly. They are always kind and ready to help young artists.

Every student of the "Ecole des beaux arts" undergoes for two years a heavy course of studies in these classes or Ateliers, and during the same time he can win medals, which entitle him to be a student of the school for lifetime.

This further exempts him from another examination. He can study the drawing at the evening class from four to six. During the winter the model is lighted by powerful lamps.

The pupil of the "beaux arts" is not bound to stay always at the above mentioned studios; he can if he prefers follow a course of high class of anatomy, where he has during winter months, bodies to dissect; he gets there one of first anatomists as master, Mr. Mathias Duval, and his able Assistant Mr. Cuyer. Both masters are always ready to help the students, calling at their studios to judge and give them some advice about the drawing of the figures which are placed in action.

In this class also pupils may get rewards, such as prize money varying from 400 to 800 francs; besides there is a prize which will afford to the student the advantage of being considered as teacher and expounder of artistic anatomy.

The section and class of perspective is based on the same rewarding principle with money prizes and otherwise.

Now comes the class for "decorative composition;" to follow this course, the student must be thoroughly advanced in architecture and modelling. Mr. Galland is the professor, under the care of whom this section is placed; he trains the pupils, and calls for correction every Saturday afternoon; he gives out then a programme which is to be followed by the student who could select any style of ornamentation he chooses. The styles must be chiefly that of Louis XIV., Louis XV., or Renaissance; these three principal styles of ornamentation are considered "classical."

As regards the documents needed by the students, they could be found at the Louvre, at Versailles, Fontainebleau and a lot of other palaces; and also in the museums, where everything in the way of arrangements and good taste may be found.

In the decorative section, as in the others, prizes both in money or in medals are rewarded to successful competitors.

TIGER.

PARIS : 1888.

#### THE PROPOSED WESTERN BENGAL RAILWAY.

SIR,—The letter signed "P Burke" in your issue of Saturday last, calls for one or two remarks in reply. The distance between Calcutta and Benares would be decreased as I said by nearly 60 miles if the Grand Chord Line is constructed. Measured on a map the distance is lessened by over 70 miles and I think in saying "nearly 60 miles" I have allowed sufficient margin for sinuosities in the hilly district just beyond Barakar. Moreover in the evidence given before the Committee of the House of Commons appointed in 1884 to enquire into the question of Indian Railways it was stated that the line had not only been proposed but that as far back as 1850 the route was surveyed and levelled and that the distance saved would be 67 miles.

I don't for a moment question "P Burke's" statement of the difficulties of the Gya-Palamow Railway or the Benares-Cuttack-Poorie Railway as found by the Survey officers but they, like the flowers that bloom in the spring, have nothing to do with the case.

Neither as far as I can see has the assertion that at a certain rate of working it would take a certain number of years to exhaust the coal beds lying between Bhagulpur and Noni-Haut.

These coal fields seem unfortunately situated. They are not near enough to Calcutta to compete with the Ranegunge and Barakar coal, nor are they far enough up country to compete with Khuraballee coal.

The proof of this lies in the fact that they are still unworked.

The Grand Chord Line would pass through what is undoubtedly the finest coal field in India—the Jherria coal field—and would thus open out a practically unlimited supply of the best coal in India now lying untouched for want of a means of transport.

F. P.



## General Articles.

### BOMBAY WATER-SUPPLY.

JOHN HAY GRANT RESERVOIR, BHANDARWADA.

THE works (see General Plan) comprise a Settling or Storage Basin, 6 Filters and a Distributing or Clear Water Basin.

(a) *The Storage Basin.*—This basin is 350 feet  $\times$  150 feet at the top, and is 30.50 feet deep, holding 30 feet of water. The inner face of the wall batters at the rate of 2" per foot, and the bottom dimensions are 340 feet  $\times$  140 feet. The capacity of this basin is 9,351,230 gallons. The section of the wall is shown on drawing No. 3. It is constructed of uncoursed rubble in chunam mortar, backed with puddle varying from 2' 0" to 3' 0" in thickness. The wall rests on a foundation of lime concrete, the thickness of which varies according to the levels and character of the old ground. The face of the wall is not pointed in cement or cement mortar. There is a bank of earth behind the puddle. This earthen bank has a top width of 20 feet with slopes of  $1\frac{1}{2}$  to 1, and runs also around the filters and distributing basins on the western and southern sides. The floor of the basin is made of 18in. of lime concrete covered with  $\frac{1}{2}$ in. Portland cement plaster, 1 of sand to 1 of cement, on the top of which was to be laid  $\frac{1}{2}$ in. of artificial asphalt: this, however, was changed to  $\frac{1}{4}$ in. neat Portland cement.

(b) *The Filters.*—The filters are 6 in number; 5 of them are 200 feet  $\times$  80 feet each, and the 6th, 145 feet  $\times$  110 feet. Drawing No. 3 shews the general style of construction. The floor is formed of 9in. lime concrete, finished with cement mortar and neat cement plaster as in the Storage Basin. The walls are of uncoursed rubble in lime mortar not pointed.

The area of each filter is about 16,000 square feet: the aggregate area 96,000 square feet. The partition walls are 7' 0" high and from 3' 6" to 4' 0" in thickness.

The water capacity over the sand is 1,800,000 gallons.

(c) *The Distributing Basin.*—This basin is an irregular cross in plan. The walls are of similar design and construction to the Storage Basin walls, the section being modified for the smaller height of water in this basin. The top water level in each basin is 190 T. H. D.; the floor level of the Storage Basin is 160 T. H. D.; of the Filters, 183.50 T. H. D.; of the Distributing Basin, 175 T. H. D. The Distributing Basin, therefore, only contains 15 feet of water when filled and having an area of about 78,000 square feet, contains about 7,300,000 gallons. The floor is similarly constructed to the floor of the Storage Basin, but is only 12in. thick.

The Distributing Basin is roofed over with brick arches carried on brick piers brought up from foundations beneath the floor of the basin. The upper surface of the arches is soiled over and forms the site of the garden.

*Inlets and Outlets.*—The 32in. inlet, 48in. outlet and 24 in. scouring pipes are passed through the Storage Basin wall in a brick-in-cement culvert in neat Portland cement, the pipes being enclosed in ashlar masonry, and a similar arrangement passes the 48in. and 24in. delivery and scouring pipes out of the Distributing Basin. There is also a direct 32in. delivery pipe to the filters at the level of 190 T. H. D. The water can be passed from the Storage Basin to the filters when the Storage Basin contains 29 feet of water. The clear water is admitted to the

Distributing Basin through penstock openings in the walls.

It should be noted that the floor of the basins is in some part, on the western side, above the level of the natural surface. In these places the foundations for the floors were built up in layers of concrete and rubble.

#### Cost of Bhandarwada Water-Works.

	Rs.	As.	P.
Ellapa Ballaram and Co., Contractors for the construction of the Reservoir ...	6,14,166	13	3
Bhedwar and Co., Contractors for laying 48" and 32" mains ...	40,712	4	7
Iron Work from England ...	2,43,396	7	1
Compensation for ground (including Rs. 1,15,000 paid for the hill to Mr. Purmanundas) ...	1,33,848	0	0
	Rs. 10,32,123	8	11
Contingencies and Establishment ...	19,151	3	8
Total Rs. ...	10,51,274	12	7

#### MALABAR HILL RESERVOIR.

The following is a History of the Reservoir (see General Plan).

The land for the Reservoir was handed over to the Municipality on the 19th February 1877, and the works were commenced at once. The tender of Mr. Haji Kassum Joosub was accepted.

The rock excavation proved to be greater than was anticipated, and the commencement of walling was delayed until the whole of the blasting was over. After that the masonry was pushed forward as quickly as possible, consistent with soundness. The floor was postponed until the question of roofing was settled.

It was decided to add filters, settling and storage basins under one roof. "Before this had been decided upon, the flooring and pointing could not have been undertaken, as the carrying out of the new arrangement would have necessitated making holes in the floor for the roof columns, and would have rendered the pointing liable to be broken and injured during the progress of the work."

In January 1880 the work was taken out of the hands of the Contractor, and the works were stopped. In the hot season of 1880, the supply to the city direct from the Tulsi Main was irregular, and there were many complaints. It was therefore decided (with a view to utilize the storage immediately) to divide the Reservoir by the construction of partition walls and to complete the floor and pointing of the walls. This contract was let in September 1880, and the works were completed in February 1881, having been supervised by Mr. Braham in the absence of Mr. Walton on sick-leave. The water was first admitted to the Reservoir on the 1st January 1881. The Reservoir was found to be water-tight and sound. There remained the settlement of the question of roofs.

On the 3rd April 1882, contract for the construction of filters was let to Messrs. Burjorji Rustomji and Co., to be completed on the 18th April 1883. The total cost of filters was Rs. 1,23,229-9-3.

The work was, however, not completed until 17th June 1884.

Finally, the contract for roofing was let to Messrs. Littlewood, Fallonji and Co., on the 23rd December 1884, and the works were completed in June 1887. The contract amount was Rs. 3,38,218.

SOME Canton manufacturers are considering the advisability of transferring their industries to Hong-Kong, provided the Government will give them facilities. White and red lead, glass, leather, and nail factories are among the industries they are desirous of bringing into the colony.



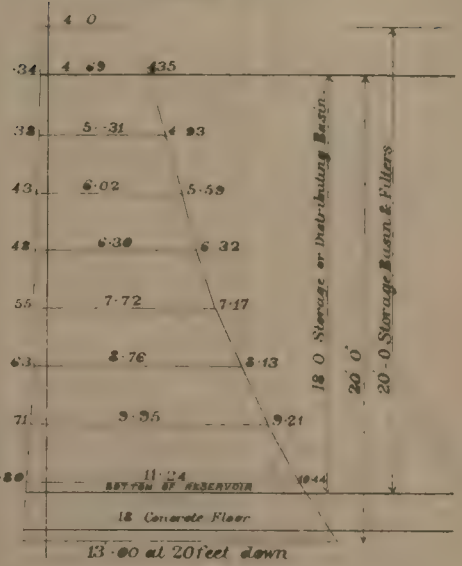
# ENGINEERING DRAWING

OF STORAGE DIR.

No. 2.

No. 1

SECTION OF WALL OF  
STORAGE OR DISTRIBUTING  
BASIN.



Scale 1 inch = 8 Feet.

DOOF.

No. 4.

GARDEN

194.0 T. H. D.

BRICK ARCHING.

190.00 T. H. D.

FILTER

183.50 T. H. D.

RUBBLE MASONRY  
IN LIME MORTAR.

CONCRETE

1/2 Portland Cement Plaster  
1/4 Neat Cement

CONCRETE

10.6







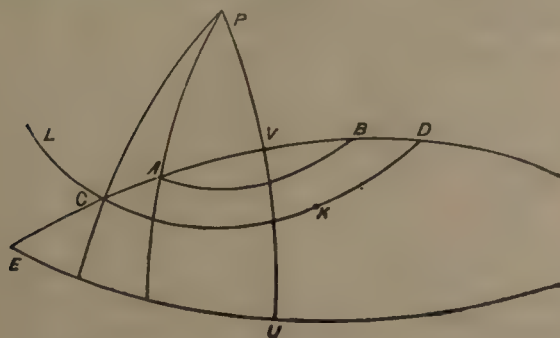
## NOTES ON NAVIGATION.

BY A. EW BANK.

## VIII.

WE may now consider a few problems on the rhumb line.

Fig. 17.



In *fig. 17* an arc  $AB$  of length  $2s$  is bisected at  $V$ . The rhumb line for  $AB$  is thus a small circle of latitude. The deviation between the great circle and the rhumb line at  $A$ , we shall for shortness call the deviation at  $A$ . This angle is  $\gamma - PAV = 90^\circ - PCAV$ .  $CD$  is an arc of length  $4s$  and it also is bisected at  $V$ . The deviation at  $C$  is  $90^\circ - PCV$ .

Now, we found that for an infinitesimal arc  $\sigma$  we had

$$\gamma - A = \frac{\sigma}{2} \sin l \sec^2 l \cos \alpha.$$

If we double the arc  $\sigma$  we shall here double the deviation.

Thus we know that if in *fig. 17* the arcs  $CD$  and  $AB$  while preserving their ratio are indefinitely reduced in length, the deviation at  $C$  is ultimately double that at  $A$ .

Hence we are led to propose the following question. If the arcs  $AB$  and  $CD$  are by hypothesis not infinitesimal; will it be possible so to choose them and so to choose the great circle  $EV$  on which they lie, that the deviation at  $C$  shall be exactly double that at  $A$ .

$$\text{If } 90^\circ - PCV = 2(90^\circ - PAV)$$

we have

$$\begin{aligned} \sin\{90^\circ - PCV\} &= \sin\{180^\circ - 2PAV\} \\ \text{or } \cos PCV &= \sin 2PAV. \\ \text{Now } \tan PCV &= \frac{\tan PAV}{\sin CV} \end{aligned} \quad (2)$$

If  $\beta$  be any angle and if  $\tan \beta = \frac{m}{n}$

$$\text{Then } \cos \beta = \frac{m}{\sqrt{m^2 + n^2}}$$

$$\text{and } \sin 2\beta = \frac{2mn}{m^2 + n^2}$$

$$\text{Let } VU = \text{latitude of } V = \lambda$$

$$\text{and let } \cot \lambda = \mu$$

$$\therefore \tan PCV = \frac{\mu}{\sin 2s}$$

$$\cos PCV = \frac{\sin 2s}{\sqrt{\mu^2 + \sin^2 2s}}$$

$$\text{Similarly } \tan PAV = \frac{\mu}{\sin s}$$

$$\sin 2PAV = \frac{2\mu \sin s}{\mu^2 + \sin^2 s}$$

$$\text{If then } \cos PCV = \sin 2PAV$$

$$\text{we shall have } \frac{\sin 2s}{\sqrt{\mu^2 + \sin^2 2s}} = \frac{2\mu \sin s}{\mu^2 + \sin^2 s}$$

As  $s$  is an arc not infinitesimal, we may divide out by  $\sin s$

$$\therefore \frac{\cos s}{\sqrt{\mu^2 + \sin^2 2s}} = \frac{\mu}{\mu^2 + \sin^2 s}$$

Let us square and clear off fractions.

$$\cos^2 s \left\{ \mu^4 + 2\mu^2 \sin^2 s + \sin^4 s \right\} = \mu^4 + \mu^2 \sin^2 2s$$

$$\therefore \cos^2 s \sin^4 s = \mu^4 \sin^2 s + 2\mu^2 \sin^2 s \cos^2 s$$

$$\cos^2 s \sin^2 s = \mu^4 + 2\mu^2 \cos^2 s$$

$$\therefore \cos^4 s + \cos^2 s \sin^2 s = \mu^4 + 2\mu^2 \cos^2 s + \cos^4 s$$

$$\text{or } \cos^2 s \left\{ \cos^2 s + \sin^2 s \right\} = \left( \mu^2 + \cos^2 s \right)^2$$

$$\cos s = \mu^2 + \cos^2 s$$

$$\cos s(1 - \cos s) = \mu^2$$

This condition though necessary (if the angle at  $C$  is to be double that at  $A$ ), is still not sufficient. For our original relation  $90^\circ - PCV = 2(90^\circ - PAV)$  gives  $2PAV = 90^\circ + C$ .

Now, we deduced the relation

$$\sin 2PAV = \cos PCV$$

But this latter relation would equally well have arisen if the original relation had been

$$2PAV = 90^\circ - PCV.$$

Again, by squaring both sides we obtained a result which we should equally have obtained had we started with the equation

$$\sin 2PAV = -\cos PCV.$$

Now, because  $2PAV = 90^\circ + PCV$  we require  $PAV$  to exceed  $45^\circ$

$$\tan PAV = \frac{\cot \lambda}{\sin s}$$

$$= \frac{\mu}{\sin s}$$

$$\therefore \mu > \sin s$$

Hence

$$\cos s(1 - \cos s) > \sin^2 s$$

$$\therefore \cos s > \cos^2 s + \sin^2 s$$

$$\cos s > 1$$

This result being impossible we infer that we cannot have the deviation at  $C$  exactly double of that at  $A$ . If we recommence by inquiring whether the deviation at  $C$  can be more than double that at  $A$ , we shall, by pursuing the same reasoning have

$$\cos s(1 - \cos s) > \mu^2$$

$$\mu^2 > \sin^2 s$$

$$\therefore \cos s > 1.$$

We therefore infer that the deviation at  $C$  is always less than double that at  $A$ . We may vary the latter part of the reasoning as follows:—If the  $C$  deviation is never exactly double the  $A$  deviation, the former must be always more than double of the latter or always less than double. For if we had one case in which the ratio exceeds 2, and another case in which it is less than 2, we could pass from one case to the other by small variations, and so obtain a case where the ratio was exactly 2.

It suffices therefore, to examine any one numerical case. If this case gives the ratio less than 2, the ratio must for all cases be less than 2.

Accordingly in *fig. 17*, suppose  $VA = 45^\circ$  which makes  $C$  coincide with  $E$ ,

$$\text{Let } \lambda = 45^\circ$$

$$\text{Then } \tan PAV = \frac{\tan PAV}{\sin AV}$$

$$= \frac{\cot 45^\circ}{\sin 45^\circ}$$

$$= \sqrt{2}$$

$$\therefore \tan (\text{deviation at } A) = \frac{1}{\sqrt{2}}$$

The tangent of double this deviation will be

$$2 \cdot \frac{1}{\sqrt{2}}$$

$$1 - \frac{1}{2}$$

$$= 2\sqrt{2}$$

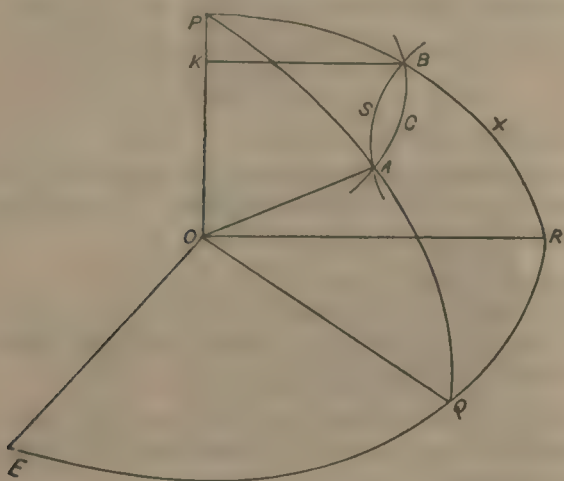
This angle is more than  $45^\circ$ . But the deviation at  $C$  or



E is  $45^\circ$  if we take the great circle C V D and compare it with its rhumb line the Equator. Thus the deviation at C must always be less than double that at A.

We may now examine another question, when the rhumb

Fig. 18.



line is still a small circle. In fig. (18) E O R is the Equator and P Q, P R are fixed Meridians. A is in P Q and has a variable co-latitude  $x$ . B has an equal co-latitude, A S B is a great circle arc, and A C B is the corresponding rhumb line or small circle. In sailing along A C B instead of on the great circle A S B, we have to travel a certain extra distance  $y$ .

If we have  $x=90^\circ$ , the distance A S B is the greatest possible, but  $y$  vanishes because the Equator is its own rhumb line. If we take  $x=0^\circ$ ,  $y$  again vanishes because A S B and A C B are separately zero. Thus, as  $x$  changes from  $0^\circ$  to  $90^\circ$ , the quantity  $y$  starts from zero and again ends with being zero. For values of  $x$  between  $0^\circ$  and  $90^\circ$  there is always some non-vanishing value for  $y$ . It is required to find that value of  $x$  which gives a maximum value to  $y$ .

We must not hastily assume that  $x$  will be  $45^\circ$  for the value of  $x$  may depend on the arbitrary constant value assigned to Q R.

Let Q R, or the angle Q O R =  $2\lambda$ . Let O Q the radius of the earth =  $r$  in nautical miles.

Then arc A C B =  $2\lambda$ . A K In the triangle Q K A when K is the centre of the small circle A C B, we have O K A =  $90^\circ$  and K O A =  $x$

$$\therefore A K = O A \sin K O A$$

$$= r \sin x$$

Thus A C B =  $2r\lambda \sin x$ .

In the great circle A B let S be the middle point. Then

$$A B = 2 A S$$

$$\sin A S = \sin A P \sin \lambda \quad (1)$$

$$= \sin x \sin \lambda$$

$$A S = \sin^{-1} \{ \sin x \sin \lambda \}$$

$$A B = 2 \sin^{-1} \{ \sin x \sin \lambda \}$$

Here A B is measured in circular measure.

The distance A S B in miles is

$$2r \sin^{-1} (\sin x \sin \lambda)$$

Therefore  $y$  the difference between A C B and A S B is

$$2r \lambda \sin x - 2r \sin^{-1} (\sin x \sin \lambda)$$

$$\frac{y}{2r} = \lambda \sin x - \sin^{-1} (\sin \lambda \sin x)$$

For a maximum we require  $\frac{1}{2r} \frac{dy}{dx} = 0$

$$\therefore \lambda \cos x - \frac{\sin \lambda \cos x}{\sqrt{1 - \sin^2 \lambda \sin^2 x}} = 0$$

As  $\cos x$  is not zero, our equation gives

$$\lambda^2 = \frac{\sin^2 \lambda}{1 - \sin^2 \lambda \sin^2 x}$$

or

$$\sin^2 x = \frac{\lambda^2 - \sin^2 \lambda}{\lambda^2 \sin^2 \lambda}$$

As  $\lambda$  is known, this equation gives  $x$ .

As an example let  $2\lambda = 180^\circ$

$$\text{Then } \sin^2 x = \frac{\lambda^2 - 1}{\lambda^2}$$

$$\cos^2 x = \frac{1}{\lambda^2}$$

$$\cos x = \frac{1}{\lambda}$$

$$= \frac{2}{\pi}$$

This gives Q A or the latitude =  $39^\circ 32'$  approximately.

If we desire the value of  $x$  to be  $45^\circ$ , we have

$$\frac{1}{2} = \sin^2 x$$

$$= \frac{\lambda^2 - \sin^2 \lambda}{\lambda^2 \sin^2 \lambda}$$

and the corresponding value of  $\lambda$  can be found approximately by successive trials.

If we assume  $\lambda = 30^\circ$ , our equation for  $x$  is

$$\sin^2 x = \left( \frac{\pi}{6} \right)^2 - \frac{1}{4}$$

$$= \frac{1}{4} \left( \frac{\pi}{6} \right)^2$$

$$= \frac{4\pi^2 - 36}{\pi^2}$$

On trial we find this fraction to be less than  $\frac{1}{2}$ .

Thus  $x$  is less than  $45^\circ$ . When  $\lambda$  was  $90^\circ$  we had  $x = 90 - 39^\circ 32' = 50^\circ 28'$ . Thus for some value of  $\lambda$  between  $30^\circ$  and  $90^\circ$  the value of  $x$  must be  $45^\circ$ .

We may now inquire to what extent  $x$  may diminish, if we make the arc Q R contract to zero. By Trigonometry we know that if  $\lambda$  be any angle

$$\sin \lambda = \lambda - \frac{\lambda^3}{1, 2, 3} + \frac{\lambda^5}{1, 2, 3, 4, 5} - \&c.$$

In the expression

$$\sin^2 x = \frac{\lambda^2 - \sin^2 \lambda}{\lambda^2 \sin^2 \lambda}$$

We thus obtain

$$\sin^2 x = \frac{\lambda^2 - \left( \lambda - \frac{\lambda^3}{6} \right)^2}{\lambda^2 \left( \lambda - \frac{\lambda^3}{6} \right)^2}$$

if we neglect higher powers than  $\lambda^3$

$$\text{Thus, } \sin^2 x = \frac{\frac{2\lambda^4}{6} - \frac{\lambda^6}{36}}{\lambda^4 - \frac{2\lambda^6}{6} + \frac{\lambda^8}{36}}$$

If we here neglect all but the lowest powers, we deduce

$$\sin x = \frac{1}{\sqrt{3}}$$

This gives  $x = 35^\circ 16'$  approximately. The corresponding latitude is thus  $54^\circ 44'$ . Thus the latitude ranges from  $39^\circ 32'$  to  $54^\circ 44'$  as Q R changes from  $180^\circ$  to zero. We cannot therefore for any given value of the longitude Q R, have the position of maximum difference for arc A C B—arc A S B either less than  $39^\circ 32'$  or greater than  $54^\circ 44'$ . These limits of course are approximate.

In dealing with rhumb lines that stretch over arcs of  $180^\circ$  of longitude, or even arcs of  $30^\circ$  we transcend the usual conditions of the sailor's life. But he may if sufficiently enthusiastic yearn for freer conditions in some other nautical existence.

Our Scandinavian ancestors had a heaven which exactly



agreed with their robust tastes. They went out in the morning and hunted a mighty boar. After a spirited struggle he was slain, and he was duly carried home for supper. In the night he collected his disjecta and digested membra, and was off to the forest again. Next day, he was again hunted and again cooked and so *ad infinitum*.

Following the precedent of these our worthy ancestors, let us picture to ourselves such a heaven as an enthusiastic skipper would enjoy.

It is a world with not too much land. There is an entire absence of isolated rocks and little in the way of shoals. The compass points true to the pole in sublime unconsciousness of heavenly magnetism or lumps of iron in the neighbourhood.

Hurricanes indeed, come with all their accustomed vigour, but only with a clear sky, so that, when the ship is blown out of her course the navigation officer can cry his cry of "stop" and determine his longitude to a minute.

Here and there a small island may be placed to be handy for picnics or for spiritual honeymoons. But such islands are moveable. If a gallant skipper proposes to sail on a single rhumb line for the magnificent sweep of 2,000 knots; all he has to do is to notify some intelligent Hydrographic department, and obstructive islands are promptly mobilised *i.e.*, towed out of the way.

Readers of these papers who themselves are sailors, and who can feel that such a heaven would be well worth a visit, may also allow that extended rhumb lines are not unworthy of notice.

## SEWAGE REMOVAL AND GAS-POISONING.

BY J. WALLACE, C.E., BOMBAY.

A POPULAR lecture on the removal of sewage could scarcely be regarded as complete without some reference to the properties of sewage, for although by reason of a popular fiction everybody is supposed to know something about it, there is no subject on which men disagree more confidently, and more obstinately, than on this one. It is nevertheless eminently a subject to be elucidated by experiment, for in all its phases it is dominated by natural law.

Sewage may be defined as waste organic matter, of animal and vegetable origin, more or less mixed with water. It is produced wherever the human race congregates together, and in densely inhabited localities it forms by its decomposition one of the great checks to the increase of population.

Sewage decomposes in two manners: by oxydation, if exposed over a large surface to the air, and by putrefaction, if left in a mass in partial contact with the atmosphere. In the latter case the sewage forms new combinations among its various constituents, and discharges gases which give rise to many fatal maladies, while in the former case it disappears by a species of slow combustion. Sewage is most rapidly and most safely disposed of on cultivated land in countries where the rainfall does not interfere with its application, but none of the above methods of disposal can be carried out in a town: it has therefore become necessary to provide means for its systematic removal as soon as the town reaches a certain size.

Sewage begins to putrefy in a certain number of hours, the time varying with the local temperature and the amount of moisture contained in the air. In Bombay, for example, the putrefaction would be more rapid at a given temperature than at Cawnpore because of the greater humidity of the Bombay atmosphere. A fall in the barometer is always accompanied by an increased discharge of foul gases from putrid sewage, owing to a temporary decrease of atmospheric pressure.

Sewage begins to putrefy in about the same space of time as flesh meat, and in order to preserve healthy conditions in a town it should be removed out of contact with the atmosphere within that period, otherwise it begins to poison the air and the inhabitants. Its rate of decomposition may, however, be accelerated if it is brought into

contact with putrid matter, which at once acts as a ferment and hastens putrefaction.

Any system of collection and removal of sewage which keeps it in the vicinity of habitations after putrefaction has set in must, therefore, be wrong in principle, and dangerous to the public health. The removal of organic refuse by means of carts and manual labor is the most effective of all when carried out with promptitude on a small scale, but in a large town it is open to many objections, being costly, offensive, and in times of epidemic dangerous. Its radical defect is the number of separate working units it contains—for the greater part very ignorant men who are too numerous to supervise thoroughly.

Removal by means of underground sewers has for ages been the favorite method of disposing of sewage among civilized communities. Sewers of admirable construction have been found among the ancient cities of Rome, of Greece and of Egypt. They have also been found in the most elaborate detail before the ruins of Nineveh.

Among the ancient installations still in use those of Damascus are the best example. A copious water-supply is led from the river through the town in pipes of masonry, filling basins in all the gardens, and overflowing into the sewers, which, while the water-supply is good, are continually flushed with a copious supply. But all this work has not saved the town from frequent and terrible epidemics.

When the properties and the effects of sewer gases began to be understood, the underground masonry sewer was found not only to facilitate the decomposition of sewage, but to effect a wide distribution of the resultant gases in the dwellings and the streets above them which they were intended to protect. Most of the gases arising from the decomposition of sewage, are lighter than the air, and are thus the more rapidly dispersed in the surrounding atmosphere. In addition to this, sewage when underground, acquires the mean temperature of the atmosphere (about 82° in Bombay) and is thus warmer than the night air. This fact explains the reason of the greater discharge of foul gases at night than in the day time, both into streets and into dwellings. A dwelling-house remains warmer within, during the night hours, than the outer air, and if it is in direct communication with any sewer it becomes a chimney, drawing foul air from the sewer through its passage, and discharging it from the upper floors.

Every pipe issuing from a house through which waste water is discharged, and which accumulates putrescent matter on its inner surface, acts in the same way towards the house as a sewer, if effective means are not taken to prevent it. The slimy lining which forms on the interior surface of the pipe acts as a ferment and immediately starts decomposition in any sullage liquid that may pass through it, such as soapy water, or water in which any food has been cooked. Thus the natural rate of decomposition is accelerated in all passages, vertical or horizontal, into which putrescible matter is thrown. It is impossible to attach too much importance to this fact, which forms the basis on which any successful project for sewage removal in a hot climate must be based.

The effect of the variation of barometric pressure on the discharge of the sewer gases does not seem to have had its due share of attention among the Reports that have come under my notice, although in Bombay it is the most important of all the causes affecting it.

The diurnal variation of the barometer in Bombay amounts to one-tenth of an inch of mercury, which is equal to 13½-tenths of an inch of water. In other words, the variation of pressure of the air in the sewers of Bombay amounts to more than twice the pressure of gas in a gas pipe necessary to give a good gas light, and this is the force with which the foul gases from the sewers escape every day into the streets and into many of the houses of Bombay. The periods of minimum barometric pressure are at about 4 P.M. and 4 A.M., the afternoon



period being the lowest, and anyone who has been exposed to escapes of sewer gas will remember that between 4 and 5 in the afternoon is the time of the greatest nuisance.

This diurnal barometric variation does not include the variations that accompany important changes of weather, and which are equal at times to another tenth of an inch of mercury. When, therefore, the two barometric depressions occur simultaneously, the Bombay sewer gases would, if confined, blow through a layer of water two and a quarter inches in depth.

The influence of these phenomena on the human nervous system would form a worthy subject of study on the part of our best medical men, aided by an expert analyst, and it is not at all improbable that many symptoms, which are at present attributed to atmospheric electricity, would prove to be traceable to the gases of putrefaction. If this should be the case, many ailments at present classed as inevitable might be put on the list of preventible maladies.

All sewers which are not absolutely water-tight leak into the surrounding ground and gradually poison it. The leakage will, in dry weather, work its way towards the surface of the grounds, and, aided by the barometric variation, will discharge foul gases from the surface and through the foundations of our houses. All this leakage putrefies, for the surrounding soil soon loses its purifying properties. The color and the odour of the soil surrounding an old sewer that has recently been opened afford unmistakable evidence of what has taken place, and of what will go on as long as the sewer exists. As a rule, the subsoil of a town once poisoned by sewers, never becomes pure again until after the town disappears altogether, and the presence of the poison makes itself felt in the rate of mortality of the place as long as the cause of it continues.

In the early history of all communities all sewage and refuse is disposed of on the surface of the ground and in the vicinity of dwellings. This may be a safe procedure so long as the surface of the earth retains its antiseptic powers, but a time always comes when, by reason of surface contamination, aggravated generally by infiltrations from cesspits into wells of drinking water, a violent epidemic attacks and decimates the inhabitants.

If the sanitary history of any large town could be traced through a period of centuries in the condition of its subsoil, it would be found to become steadily fouler in direct proportion to the increase of population, of sewers or cesspits, and of water-supply.

If sewers could be made always with such an incline, and supplied with such a flow of water, as to carry away the sewage to a safe distance before putrefaction had time to set in, sanitation would be a very simple matter, but in Bombay the rapid decomposition of dead organic matter, which precipitates our funerals, is equally imperative in the matter of sewage removal. *All sewage must be completely removed from contact with the air we breathe in the shortest possible time, otherwise the general health of the town will suffer.* Sewers, and drains into which sewage enters, as they exist in Bombay at present, may justly be described as forming an immense subterranean gasworks producing poisonous gases, all of which escape into the air we breathe.

The Halalcore system in Bombay, which has had so many ardent supporters, is very far from meeting the requirements of a large town. Its sole merit appears to be that it can be established with a small capital, but, regarded as an organization for the transport of a given weight of material, the cost per ton per mile is out of all proportion to that of any other goods. In addition to this, the repeated handling the sewage receives on its passage from a house to its final destination renders the system quite unfit for any town exposed to the visits of cholera.

In a town with such a large floating population it is difficult to arrive at a true estimate of the sanitary condition by the returns of mortality. These returns,

to have their full value, should be supplemented by a thorough system of analysis of the air, the water-supply, the surface soil and the subsoil in various parts of the town; note being taken of the temperature, barometric pressure, and season. A series of observations of this kind extending over a number of years would form a valuable commentary on the work of the sanitary authorities, and it would tend to keep all sanitary work more in harmony with local conditions than has heretofore been possible.

Resuming what has just been stated on the peculiarities of sewage in a hot and moist climate, it is clear that only a very limited time should be allowed for the removal of all sewage from the town. This time may be determined by exposing a certain volume of average sewage and sullage in a cesspit of a certain depth and area during one of the hottest months of the year. Once the time in hours has been determined, it becomes the limit within which the liquid must be removed to its destination. The removal should be effected by means which will not expose it to the air.

If it is to be disposed of in the sea, the full time may be allowed, but if it is to be applied to cultivated land, the period of transport must be included in the limit of time, so that the distribution of the sewage shall not prejudice the health of the agriculturists. If it will not flow to its destination it must be pumped, and the limit of time becomes a large factor in determining the size of the pipes and the power of the pumps.

The removal of all sewage from contact with the air we breathe within a definite time suggests a process as closely analogous to that of our water-supply that it may be aptly described as the system of water-supply *reversed*.

The water-supply arrives in the town and is distributed in iron pipes, which not only prevent its escape by the way, but also preserve it from contamination, while a pneumatic system of sewage removal carries away the same water when rendered foul and dangerous to human life by a similar set of pipes, which prevents it from escaping and contaminating the soil and the air. And in order to get the greatest amount of sewage through the pipes, or in other words to make the smallest pipes serve the purpose, pumps are used to increase the velocity of flow in the pipes.

Where mixed sewage and sullage are collected in a closed receptacle and pumped out periodically, it is necessary that the passage to the pump should be closed as soon as the receptacle is empty, otherwise air will enter the pipes and the effect of the pump will be greatly diminished.

The valve I am about to shew you is designed for this purpose. It is constructed so as to remain closed until the receiver is full to any desired height, and then to open full bore until the receiver is empty. It consists practically of two working pieces, and has neither levers nor stuffing box to cause derangement.

Let us imagine a district of the town traversed by a network of iron pipes converging to a pumping station. The branches of the pipes terminate in water-tight receivers situated below the streets, each receiver serving ten or a dozen houses, or say 200 people.

If the mixed sewage and sullage amounts to an average of 7 gallons per head per day, or 1,400 gallons in all, a receiver to hold it would measure 225 cubic feet. This doubled to provide for contingencies would require a receiver 10 feet long 8 feet high and 6 feet wide. The receiver is in fact a short tunnel of uniform height and width and of a length to suit local requirements.

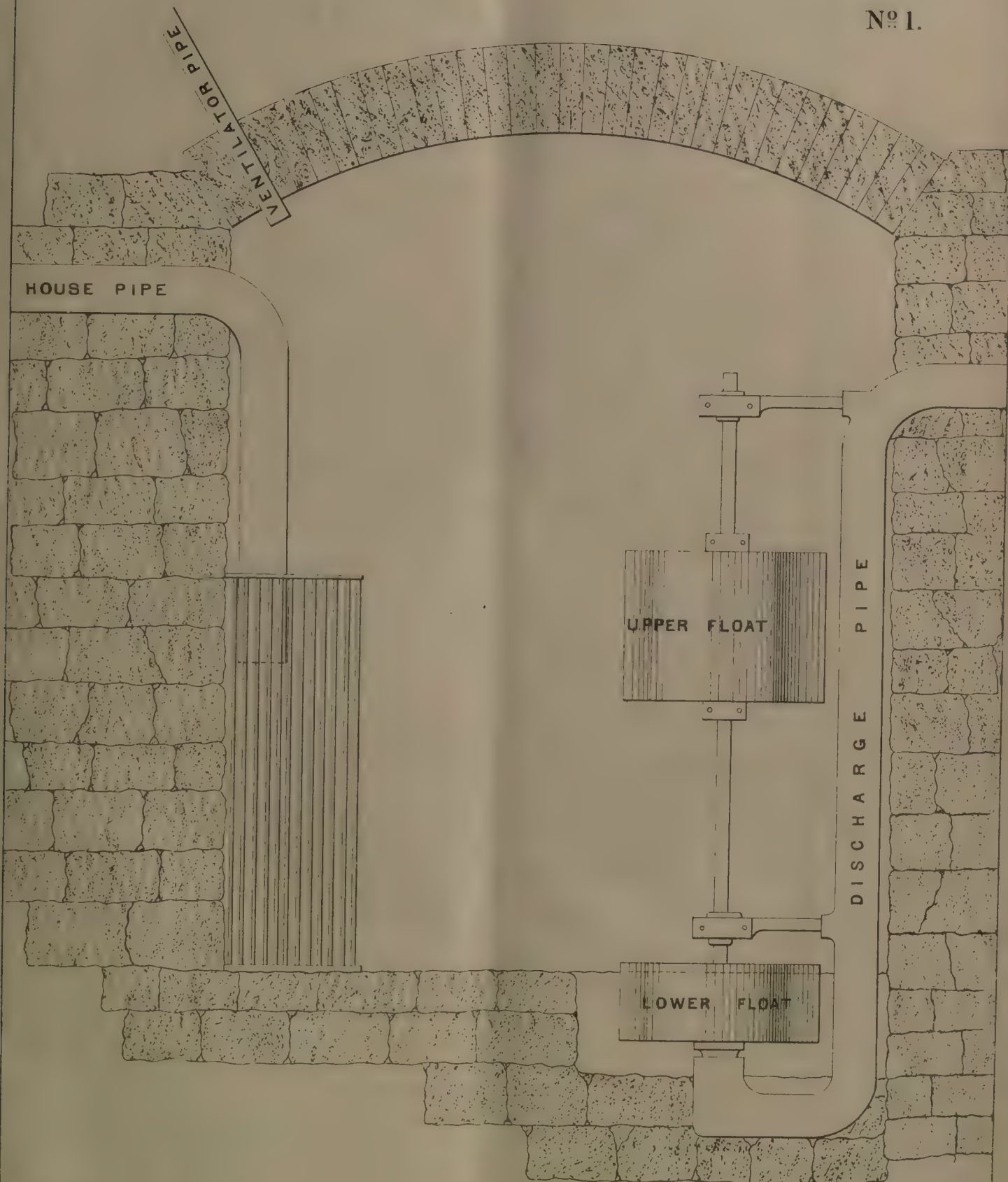
The Diagram No. 1 before you represents a section of the tunnel with the discharge valve placed in a recess in the floor. The discharge pipe which enters the receiver near the roof passes down the wall so that the mouth opens upwards from the bottom of the recess. The valve cover which closes the opening is attached to a vertical rod carried in suitable brackets, so that the valve



# THE REMOVAL OF SEWAGE BY PNEUMONIC APPARATUS.

By J. WALLACE, C. E.

No 1.









cover may rise and fall freely without missing its seat. On the rod are fixed two water-tight metallic floats, and their size is so proportioned that the combined floating power of both is required to open the valve, which is ordinarily held shut by the suction of the pumping engine. One of the floats is fixed at the bottom of the rod immediately above the valve: the other is near the top of the rod, but its position may be altered to any other height.

We shall now suppose the receiver to be empty and the pumping engine at work producing a partial vacuum in the collecting pipes and holding the valve shut. The waste water and sewage from the houses in connection with the receiver gradually accumulate, the depth of liquid increases in the receiver and the lower float is completely covered, but the valve remains closed. At length the upper float begins to be immersed, and its floating power added to that of the lower one overcomes the power of the pump, and suddenly raises the valve to full open. The liquid then begins to leave the receiver by the discharge pipe, and as the level falls, the valve is kept wide open by the lower float, which is large enough to carry the weight of the upper one.

(To be continued.)

#### NOTES FROM HOME.

(From our own Correspondent.)

THE first through train on the new Eastern Railway between Vienna and Constantinople was run on Sunday last, and it is intended in the future that the service shall consist of one train daily running *via* Pesth and Belgrade, the journey occupying about 48 hours. Preparations are being made with the Continental Railway Companies for this new oriental express to run through from Paris to Constantinople, so that at last the Turkish capital will be placed in direct Railway communication with the rest of Europe. When the service has thus become consolidated, it is expected that the journey from London to Constantinople will be accomplished in 4½ days. The scenery on the new line is some of the most charming in Europe; for instance, through the Nichava Pass the Railway is carried along a mountain side for the length of about 10 miles with perpendicular rocks towering 300 feet above, and a mountain torrent 200 feet below.

A new Storage Reservoir for the Grand Junction Water-Works for supplying half of London with water has just been brought into use. It is situated on Mount Park Hill, Ealing, and the water stored there is intended to be kept in reserve to meet periods of excessive drought, &c. It covers more than 6 acres of ground and is 45 feet deep, and will contain 51 million gallons. It is lined with Portland cement concrete and its slopes are paved in vitrified brick. The water to supply it will be pumped through a 30-inch main from the New Bridge Works.

The eminent Sanitarian, Sir Robert Rawlinson, has just made a vigorous protest against the policy of the Moribund Metropolitan Board of Works in dealing with the London sewage. He asserts that the 50 cases of sewage tanks and the works will prove intolerable; that the iron barges will be found incumbrances to the river, and that the working expenses will be enormous, and practically thrown away. He repeats his well-known views that in irrigation will be found the solution of this great and pressing problem.

The Metropolitan Railway Company are about to carry out extensive alterations and additions to St. John's Wood, Baker Street Station, as it has found that since the completion of the Pinner and Rickmansworth Extension its present accommodation is totally inadequate to the requirements of the increased number of passengers. The space of ground on which it is proposed to erect the new station embraces a large area, commences near Madame Tussaud's Exhibition, and extending a few yards past the present station. It is intended to widen the old station on both platforms so as to give facilities of changing from the branch to the main line trains. An additional bridge will also be thrown over the station to connect the St. John's Wood line with the west side of the station.

The Railway race to Edinburgh is still exciting great interest. The London and North-Western Railway Company, has still further reduced the time in which their 10 o'clock express runs to Edinburgh, having taken another 15 minutes

off, and advertised their train to reach Edinburgh in 7 hours and three-quarters, being the same as that on the Great Northern Railway. The Company have further issued an order to their Locomotive Works at Creine for 20 new engines with 7½ feet driving wheels, to be constructed especially for high speed. It has to be seen whether the public will appreciate these racing trains, which, if successful, must mean an increased rate of speed to the principal commercial centres of England, for Bristol, Manchester and Liverpool will not be satisfied if the boon extended to Edinburgh is not granted to them. It must be borne in mind that these trains are light, weighing about 80 tons exclusive of engine and tender. In this they contrast very strongly with the express trains on the Brighton Railway; for instance, the 8-45 A.M. first-class express from Brighton to London weighs between 330 to 350 tons, or considerably more than double the North-Western train.

Corresponding with this race between the Railways we have also a struggle for supremacy between the Trans-Atlantic Steamships. The latest specimen of express marine machinery is the *Inman* and International liner *City of New York*, which is the largest passenger steamer afloat, and is a most remarkable achievement of the Naval Architect. When the *Etruria* and *Umbria* were built, it was thought that the limit was reached, for they possessed an unprecedented engine power compared with tonnage. Now it seems that two indicated horse-power per ton of displacement is not considered too much, and the performance of the *City of New York* and her sistership, the *City of Paris*, will be watched with interest by all Marine Engineers. These boats cost about £300,000, and their engines indicate as much as 20,000 horse-power. The *City of New York* is 565 feet long and 76 feet high from keel to captain's bridge, but there are already indications that attempts will be made to eclipse these latest triumphs of the Marine Engineer.

There has been for sometime a war of rates between the companies possessing Atlantic Cables, and it has been very damaging to their several proprietors. This has now come to an end, and a uniform rate of a shilling a word has been generally agreed upon. During the past two or three years there has been, as the outcome of experiments, and of the continued experience, further knowledge gained, which leads to the belief that the life of a cable under the waves is longer than had been thought. During the last few months the cable of the Direct United States Company has been raised from a depth of over 2,000 fathoms, a fault cut out of it, and the repairs made, and as the cable has lain above a dozen years on the ocean bed, the task must be considered important, and its success must be considered to give ground for the belief that the endurance of a cable is longer than has been hitherto held.

At the Meeting of the British Medical Association, held at Glasgow, Mr. James, of London, read a paper advocating the appointment of a Minister of Public Health. He admired the French system of hospital organization under State auspices and considered that the appointment of a Minister of Public Health for England would be of no less advantage than that of the other time-honored seats in the Cabinet.

#### THE INDIAN COAL FIELDS.

##### II.

(From our own Correspondent.)

THE Raniganj Coal Association are struggling along as well as able under the present régime, which has done much to save the concern from the verge of liquidation.

Apcar's Collieries are just emerging from an ocean of trouble, and under new management bid fair to do as well as of yore. Mr. Agabeg Agabeg—the famous "Beggie"—is the guiding hand of the new régime, and his well-known energy is an augury of success. I may mention that Mr. Agabeg's suggestions for opening out Sonthalia by a narrow gauge Railway, with the view of developing the mineral and other resources of that little-known country, formed the subject of a memorial to the Lieutenant-Governor of Bengal on his recent tour through that part of the Province.

The E. I. R. Collieries have lately received a re-inforcement of M. E's from home. They are brought out expressly to assist the present management in dealing with the thick seam and in working broken mines *economically*—an operation, or operations, which were initiated and worked successfully by an expert whose services were dispensed with while on leave on the score of *reduction*. Now,



this man, who was turned adrift after 12 years' service for the ostensible reason given above, holds testimonials from the present and past Managers, which many would be proud to possess, and yet we are told that his services were not required because of *reduction*! Tested by the light of after-events, the reason assigned is opposed to facts; for no sooner was he sent away than three men were introduced to do the same work which was previously done economically by a *single man*. I have no doubt that this will be borne out by existing facts and circumstances. Surely the ways of men dressed in brief authority are inscrutable.

The manufacture of hard or foundry coke is increasing apace, and it is largely consumed in the district and in iron foundries up and down country. The best coke is that manufactured at the New Beerbhoom Coal Company's works at Borra, whose output is on a par with its doings in this connection. It is stated on good authority that the charges for disintegrating the coal, converting it into coke and placing it in wagons are the lowest as compared with those of the Bengal and the Burrakur, who will be many years before they can excel the performance of the New Beerbhoom. The East Indian Railway coke is perhaps the worst in the market, and only used by the Company at their own works and in engines. Complaints are constant as to its quality and imperfect manufacture, and the tendency it has shewn of choking the cupolas has caused considerable amount of annoyance and trouble to the Locomotive Department at Jamalpore.

On dit that a compact has been entered into between the Bengal Coal Company and the Raniganj Coal Association at Giridi to maintain the present high prices of coal intended for up-country. This is a step in the right direction and worthy of imitation by the various interests in the Raniganj field, but the native element will be found an insuperable difficulty, and, even if secured, the *cordon* would be weak, because of the unreliability of the native *fibra*.

While dealing with the Raniganj Coal-field I cannot omit the mention of two important and useful industrial centres which are doing their mete of good in the district and beyond. I allude to the Burrakur Iron Works and the Raniganj Potteries.

At the former place good work has been done during the past half-year in pipes and ornamental castings, which are in great demand. The management of the works continues in the hands of our able and indefatigable friend Ritter Von Schwarz. The "Ironworks" has done a great deal for the Indian ryot, and the useful aids to his labor in the shape of simple and inexpensive ploughs and water-lifts have succeeded in arousing the ill-thought ryot to the appreciation of their utility and economy.

The other industrial work, the Potteries, is situated at Raniganj, and is owned by the wellknown and enterprising firm of Messrs. Burn and Co., of Calcutta. From the rough and ungainly potteries which characterised its incipient efforts, the work has steadily advanced to a position which does credit to the proprietors, and demonstrates conclusively the high excellence to which the ceramic art can be raised by human skill, thought and perseverance, and with purely native agency. This is the only Pottery work of any note in India, and it receives all the patronage it deserves from Government and the public.

This letter would be incomplete without allusion being made to other mining centres in India.

The Umaia coal is fighting its way against its sister mineral—the Raniganj and Kurhbari—in the Upper Provinces, and is endeavouring to indent on the ever-widening circle caused by the demand for the latter coals. Experience is more impressive and convincing than the daily advertisements which appear in some of the up-country papers eulogistic of the evaporative power and economical results. The mill-owners refuse to have the coal without the Raniganj or Kurhbari as vehicles of, or aid to, burning or ignition. They found it incapable of burning without the aid of the Raniganj coal, with which the initial fire had to be made, and one and all condemned the coal as unfit for their boilers, and worthless stuff. The only inducement which it might offer to Railways within its sphere of service to look upon it with favor and increase their demand for this coal, is the comparative low cost to the consumer—the quality being unquestionably inferior to the average of the Raniganj coals. I doubt if the enormous outlay incurred for exploring, establishing the works and bringing the coal in direct communication with

the market, would warrant the low rate at which this (Umaia) coal is offered for sale. It is said that all Government undertakings should be costly and ruinous, or else there would be no necessity for the heavy taxes under which the country groans. I believe in the *dictum* and shall endeavour to profit by it.

The Singareni field is in a *mess* just now, being unable to make a headway because of scarcity of mining labor and the *imbroglio* in which the operations of the Hyderabad (Deccan) Mining Company are involved. I shall, however, be guided by the admonitory finger of silence, and say no more on this, until occasion may arise, when your readers will be placed in possession of facts and figures which will make even the angels weep.

The Warora Colliery is beginning to shew signs of better results. The output is increasing steadily, as the fire stoppings are pushed forward, and the earnings of the year 1886-87 amounted to over 4½ lakhs of rupees! The distribution of the raisings or deliveries which were made to various Railways, mills and manufacturing companies, served by this colliery, amounted to nearly 112,000 tons, shewing an increase over 1885-86 of tons 16,000. All these figures are approximate, not actual.

The Makum (Assam) field is, meteor-like, approaching its perihelion, thus giving us an opportunity of seeing more of its phases than hitherto. By reason of its great distance, and the greater gulf which interlies the Manager of this new field and the fraternity of the old or Raniganj field, we seldom get a good view of the field which this planetary body presents in its movements in the carboniferous system, and which is destined in no distant time to play an important part in the economy of the coal-trade. The management is under the control of Mr. Turner, who has spared no pains to lighten the irksomeness of mining operations in this country; mining labor is increasing daily and the arrangements inaugurated with a view to facilitate transport above and below ground do him credit.

The Assam coal is by far the best in India, and it is now largely used by the P. and O. Company's steamers, and before long it will be placed in the Calcutta market as cheap as the Raniganj mineral. The Railway and River Trading Co. use the Assam coal exclusively, and it is much extolled for its quality and near approach to the English article. The manufacture from the Makum coal is described as excellent, but the sample seen by me was not so good as the best Raniganj. With careful washing and a better system of coking, the coke could be made to equal the best English. These items of expense, which are not favorably viewed by those engaged in the manufacture of this article, are a drawback which time alone will remove. Now to turn to other topics.

The East Indian Railway Company are busy strengthening the large span girder bridges on the Chord Line by building up central or auxiliary piers instead of replacing the girders with stronger ones. The method adopted will prove economical and efficient, and as it is under the control and management of such men as Beyts and Taylor, the result cannot fail to prove satisfactory. The extension of the E. I. R. beyond Burrakur is under the serious consideration of the Imperial Government, and if the guarantee asked for by the Syndicate, which has volunteered to construct the Railway without the usual guarantee from Government be forthcoming, the preliminaries will be set in motion soon after the rains.

The estimates and plans are ready and the statistics obtained locally and otherwise go to shew the possibility of a return equal to 4½ per cent. on the capital invested being obtained from the coal and coke traffic alone. This I have reason to doubt, but time will tell. It is required by the Government that the Coal Companies, which will be served by the extension, shall guarantee the payment uniformly of four annas per ton as freight on coal and coke despatched from any point of the line, and agree to put in their own sidings or branches from the main line, confining the conveyance of their coal by this means to the exclusion of all others.

The estimated cost of the line, 6½ miles in length, is put down at 11 lakhs of rupees, and if girders are utilised from the E. I. R. Line in the Howrah District, the cost will be reduced to a little over 9½ lakhs.

The Syndicate undertake the construction of the line on the assurance of the rate of freight stated above, and on the



E. I. R. Company agreeing to work the extension on the same general basis of the Tarkessur terms. Considering the enormous saving which will be caused to the interested mining companies, the guarantee should no longer be delayed, as it is at once reasonable and tempting.

The Bengal-Nagpore Railway Company are alive and doing, and the progress made since the commencement of the various works reflects the greatest credit on all concerned. The Dhika Ghat, where the bridge over the Damuda River will take its northern rise, is now in metallic contact with the E. I. R. Station at Asansol, where all the materials of construction are conveyed previously to their despatch to Dhika and beyond. The line which connects the two points is laid with flat-footed rails, carried by trough steel sleepers on the bare ground in places newly made, and it is intended as a temporary accommodation.

The line looked very much shaken about, and tilted up and down at almost every joint, due to the late heavy rain which has softened the ground bearing the line.

The earthwork of the Coal Service Branch running along the north bank of the Damuda River is pushed on with vigour, and if the present rate of progress and push continues, the line should be ready for traffic before the 1st January 1890, if not earlier. But the non-completion for permanent use of the Asansol-Dhika Section will militate seriously against the working of the Coal Branch; it is hoped the latter work will be constructed simultaneously.

The rains have fairly set in and are doing serious injury to the works of the less prepared portion of the mining proprietors. While some of the agriculturists cry for more rain, others with great devotion pray to Father Pluvius to cease the baneful scourge! And yet there are many among us who would gladly exchange earthly tears for heavenly ones.

This paradoxical position is induced by the fact, that while one section is efficiently prepared to meet the demoniacal visitor and holds large stocks, the other is in the reverse position, living, as it were, from hand to mouth.

## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

#### Burma, September 1, 1888.

Mr. W. Beach Campbell, Assistant Engineer, 1st grade, reported his return to duty on the forenoon of the 27th August 1888 from the leave granted him in Burma Public Works Department Notification dated the 15th September 1888. His services are placed at the disposal of the Superintending Engineer, I. Circle.

Mr. P. E. Raven, Assistant Engineer, 1st grade, Rangoon Division, is granted 28 days' language leave, with effect from such date as he may be allowed to avail himself of it.

Mr. H. G. Billings, Assistant Engineer, 1st grade, temporarily attached to the office of the Superintending Engineer, I. Circle, is granted two months and 17 days' privilege leave, with effect from the forenoon of the 4th September 1888.

Mr. D. F. Hogarth, Personal Assistant to the Engineer-in-Chief, Toungoo-Mandalay Extension, Burma State Railway, is appointed to officiate as Deputy Manager, Open Line, in addition to his present duties during the absence of Mr. H. Rigg, or until further orders.

#### Hyderabad, September 1, 1888.

With reference to Notification, dated 18th September 1884, Mr. D. M. Scobie, Assistant Engineer, 1st grade, passed his examination in reading native letters and accounts on the 31st ultimo, thus completing the test for the Departmental Standard Code.

#### Madras, September 4, 1888.

The following posting is ordered :—

Mr. J. C. Larminie, Executive Engineer, 2nd grade, to the V. Circle, Presidency Division, for special duty at Bangalore.—To join from furlough.

Mr. J. E. Lafrenais, A.C.E., B.C.E., Sub-Engineer, 2nd grade, sub. *pro tem.*, officiated as Executive Engineer, Trichinopoly Division, from the 17th to 20th June 1888, and Mr. W. V. Baker, Assistant Engineer, 1st grade, honorary rank, officiated as Executive Engineer of the same Division from 21st June to 5th July 1888.

#### Bombay, September 6, 1888.

Khan Saheb Ali Akbar, Assistant Engineer, 1st grade, held charge of the office of the Executive Engineer, Ahmedabad, from 7th to 16th August 1888, both days inclusive.

#### Punjab, September 6, 1888.

Major W. B. Whiteford, R.E., Executive Engineer, 2nd grade, attached to the Patiala-Bhatinda Railway, is allowed furlough to Europe for two years, with effect from such date as he may avail himself of the same.

With reference to Public Works Department Notification, dated 27th June 1888, Mr. T. E. Ivens, Executive Engineer, is, on return from furlough, appointed to officiate as Superintendent of Works, III. Circle, Punjab, of which appointment he took over charge from Mr. Hilton on the forenoon of 10th August 1888.

#### Central Provinces, September 8, 1888.

Rao Sahib T. N. Mukhopadhyaya, Assistant Engineer, attached to the Eastern Division, returned from the leave granted him in Notification, dated 7th June 1888, on the forenoon of the 28th ultimo.

#### India, September 8, 1888.

Mr. J. S. Beresford, Executive Engineer, 1st grade, North-Western Provinces and Oudh, is promoted to Superintending Engineer, 3rd class, temporary rank, with effect from the 25th July 1888.

The services of Mr. F. B. Hebbert, Executive Engineer, 3rd grade, State Railways, are placed temporarily at the disposal of the Director-General of Railways for employment on special duty.

The services of Mr. T. E. Owen, Executive Engineer, 1st grade, State Railways, are, on return from privilege leave, placed at the disposal of the Government of Bengal.

The services of Colonel Sir J. Browne, C.B., K.C.S.I., R.E., Superintending Engineer, 1st class, are replaced at the disposal of the Military Department, with effect from the 14th June 1887.

The services of Mr. A. T. Chiodetti, Assistant Engineer, 2nd grade, are, on his return from furlough, placed at the disposal of the Director-General of Railways.

Mr. J. H. Toogood, Executive Engineer, 2nd grade, sub. *pro tem.* (Bengal), is transferred temporarily to Madras.

Major G. Hildebrand, R.E., Superintending Engineer, 3rd class, Supernumerary, Military Works Department, is promoted to Superintending Engineer, 2nd class, temporary rank, Supernumerary, with effect from the 26th April 1887 to 14th December 1887.

#### Military Works Department.

The following promotions in the Engineer Establishment are sanctioned, with effect from the 10th August 1888 :—

Lieutenant W. G. R. Cordue, R.E., from Assistant Engineer, 1st grade, sub. *pro tem.*, to Assistant Engineer, 1st grade, permanent rank.

Lieutenant E. D. Haggitt, R.E., from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, sub. *pro tem.*

Lieutenant J. C. Rimington, R.E., from Assistant Engineer, 2nd grade, sub. *pro tem.*, to Assistant Engineer, 2nd grade, permanent rank.

Lieutenant E. A. Edgell, R.E., from Assistant Engineer, 2nd grade, temporary rank, to Assistant Engineer, 2nd grade, sub. *pro tem.*

Lieutenant O. H. Stoeher, R.E., temporary Assistant Engineer, 2nd grade, passed the Departmental Standard Examination on the 28th August.

#### Director-General of Railways.

The undermentioned Assistant Engineers, 2nd grade, passed the Colloquial Examination in Hindustani, on the afternoon of 11th August 1888 :—

Mr. R. R. Gales.

„ J. Woodside.

„ F. D. Couchman.

Mr. W. Michell, Executive Engineer, 3rd grade, sub. *pro tem.*, has been granted, by Her Majesty's Secretary of State for India, leave for nine months in extension of the fifteen months' furlough previously granted him.

#### Assam, September 8, 1888.

Mr. O. G. Smart, A.M.I.C.E., Executive Engineer, Khási and Jaintia Hills Division, who was posted in Public Works Department Notification, dated the 16th July 1888, to the charge of the Lower Assam Division, reported his arrival at Gauhati and took over charge of the office of the District Engineer, Kámrúp, from Mr. E. J. Mitchell, Assistant Engineer, and Officiating District Engineer, on the forenoon of the 21st August 1888, and of the Goalpara district from Rai Sahib Brij Mohonlal, B.A., Assistant Engineer, and Officiating District Engineer, on the forenoon of the 1st September 1888.

#### Bengal, September 12, 1888.

##### Establishment.

Mr. W. H. Rushton, Assistant Engineer, on return to Bengal from Beluchistan, is posted to the Darjeeling Division.

##### Railway.

Baboo Gopall Chandra Chattapadhyaya, Assistant Engineer, 1st grade, Eastern Bengal State Railway, is transferred to the Tirhoot State Railway.

Mr. J. D. Davies, who reported his return from Beluchistan on the forenoon of the 6th instant, is appointed to be Executive Engineer of the II. Calcutta Division.

With reference to Government of India, Public Works Department Notifications of the 3rd instant, Mr. T. E. Owen, Executive Engineer, 1st grade, is appointed to officiate as Under-Secretary to the Government of Bengal in the Public Works Department, Railway Branch, during the absence, on deputation, of Mr. F. B. Hebbert, or until further orders.



## Indian Engineering Patent Register.

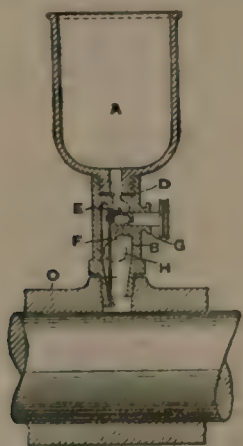
SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Revenue and Agricultural Department:—

The 25th August 1888.

- 211 of '87.—Henry Hamilton Remfry, Solicitor and Patent Agent, of 5, Fancy Lane, in Calcutta.—For improved apparatus for heating and purifying feed water before its introduction into the boiler.
- 50 of '88.—Frederick Albert Gatty, of Hagg Works, Accrington, in the County of Lancaster, England, Dyer and Calico Printer.—For improvements in dyeing cotton yarns and fabrics.
- 67 of '88.—Rudolf Katz, of Gross Kostomlat, in Bohemia, Austrian Empire, farmer.—For improvements in steam-ploughing on the double Engine system.
- 92 of '88.—Louis Boilmann, Engineer, in Vienna, Austria.—For improvements in sewing machines.
- 105 of '88.—Arthur William McLeod Keen, of Melbourne, Victoria, Australia.—For "Keen's unbreakable and light metallic racing and riding saddle-tree and improved panel."
- 119 of '88.—Amos Herbert Hobson, of 5, Westminster, England, Analytical Chemist.—For improvements in the treatment of bones and animal waste or refuse generally for the purpose of rendering the same more suited for fertilizing purposes and for obtaining gelatine, glue and size.
- 146 of '88.—Joseph Johnson Adgate and Samuel Parker Kittle, both of 34 Baldwin's Gardens, Gray's Inn Road, in the County of Middlesex, England.—For improvements in the manufacture of knitted fabrics.
- 147 of '88.—Samuel Parker Kittle and Joseph Johnson Adgate, both of 34 Baldwin's Gardens, Gray's Inn Road, in the County of Middlesex, England.—For improvements in circular knitting machines.

### RECENT AMERICAN PATENTS.

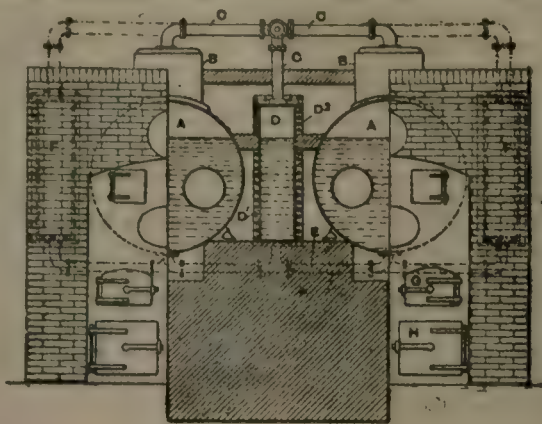
AXLE LUBRICATOR.—G. W. Brown, West Newbury, Massachusetts.—The flow of oil from this lubricator is regulated according to the temperature of the bearing. The cup A holds the oil, and the stem B is screwed into the bearing. The screw G is provided for the purpose of cutting off and opening the supply of oil; the oil passes through perforations in the hollow end of the screw, and out through



the valve E. A sight hole is provided at H. A double strip of metal F is screwed at one end to the bearing and the other carries the valve E. It follows that the degree of heating of the bearing will control the opening and closing of E, as the heat will have the effect of bending the double strip of metal F. Six claims are made for the operation of this valve by the variation of temperature.—No. 382752, 15th May 1888.

### RECENT BRITISH PATENTS.

STEAM BOILERS.—J. W. Oldroyd, London.—The object of this invention is to utilise the heat which is otherwise absorbed by the brick work. Instead of making the walls of the flues of brick work, the inventor replaces them by long thin steam generators, which are connected with the main steam pipe, or with the steam chest of the boiler. The accompanying figure illustrates an application of this method. A, A are the steam boilers proper, and B their steam chests; D is the auxiliary boiler or economiser, which is constructed of boiler plates D<sup>1</sup>, and strengthened by angle iron D<sup>2</sup>. This economiser is connected to the boilers by the tubes E; and the steam pipes C connect the steam chests, economiser, and main steam pipe. Two claims are



made for the combination of the boilers A, steam chests B, steam tubes C, and water pipes E, with the auxiliary boiler D, which is constructed as described.—No. 3216, 2nd March 1888.

## ADVERTISEMENTS.

### PUBLIC WORKS DEPARTMENT.

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 out of employ is kept up by the—  
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 of scrap, cast and wrought iron and other  
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5. Cawnpore „ 8th „ „
6. Ghaziabad „ 12th „ „
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Terms cash before removal, and a deposit of  
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 maining on the Company's premises.

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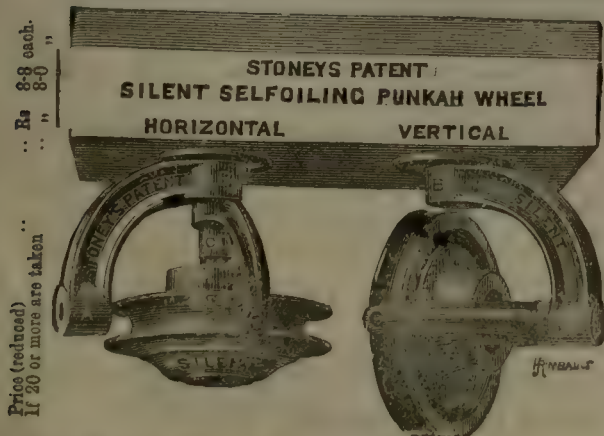
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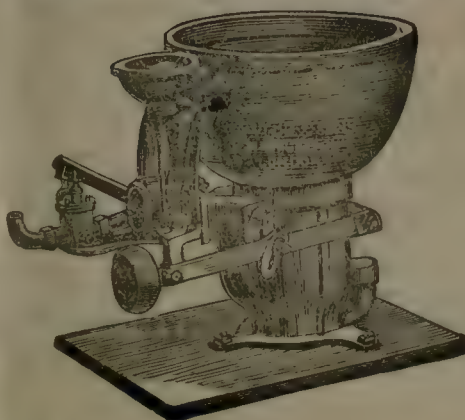
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Cast-iron Fire-bars, Floor-plates, Plain Columns, &c., from	" 5-0 " "
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Cast-iron Ornamental Columns, railings, gates, spiral staircases, porticos, brackets, arch-fillings, &c., in great variety	At cheapest rates.
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## COMMERCIAL UNION ASSURANCE CO., LD.

*Extracts from the Twenty-sixth Annual Report viz. for the year 1887.*

### FIRE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£769,265 0 0
Interest ...	£ 19,612 0 0
Losses after deducting Re-insurances ...	£443,587 0 0

### LIFE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£125,559 0 0
Interest and Dividends ...	£ 45,649 0 0
Claims less Re-insurances, ...	£ 79,229 0 0

### MARINE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£175,118 0 0
Interest ...	£ 8,294 0 0
Losses after deducting Re-insurances ...	£138,365 0 0
Interest not belonging to above, but included in Profit and Loss ...	£ 18,545 0 0

The Life Fund was increased during the year by £65,648 and now amounts to £1,070,064.

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the uncalled Capital of £2,250,000.

The rates of Premium are moderate, but they are not unsafely low, and will be found to stand the test of time, thereby in conjunction with the ample Funds affording absolute security to the assured.

The Total Funds and property in hand on 31st December 1887 stood at £2,613,059.

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It is particularly requested that all letters on business concerning subscriptions and advertisements be addressed to the "Managing Agents," MESSRS. BALMER, LAWRIE & Co., 103, Clive Street, Calcutta; and all remittances be made payable to them.

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"Artesian Borings in the Sunderbunds."

As the issues of the journal containing the articles headed as above are out of print, and sufficient inducement having offered, the matter has been reproduced in pamphlet form to meet the requirements of District Officers and others in Bengal and elsewhere.

Price Rs. 2 per copy.—Cash.

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Obituary.

RHIND.—At Gorakhpore, suddenly, on the 11th inst., James Rhind, Locomotive Superintendent, Bengal and North-Western Railway.

INDIAN ENGINEERING.

SATURDAY, SEPTEMBER 22, 1888.

POSITION AND PROSPECTS OF CIVIL ENGINEERS IN THE PUBLIC WORKS DEPARTMENT.

II.

It is not safe to deny claims, the justice of which has been officially admitted in the case of men who have the spending of 14 millions sterling per annum. The inevitable result will be, in the present, carelessness and laxity in supervision; (and we may remark that laxity to the extent of 3 per cent. on the Budget allotments would come to quite 4 lakhs per annum), and in the future a different class of officers who will pay themselves what the Government denies to those who do their duty. All this has been admitted on these and other grounds ever since 1876, and various schemes have from time to time been put forward, beginning with the Close Committee appointed by Government, on which the Civil element, though composing more than 2/3rds of the Department, was unrepresented, down to the Public Service Commission of last year. But "while the grass grows the steed starves," and we trust that the present Public Works Minister, will seriously turn his attention to the necessities of the case, as much in the interests of the Department as the taxpayer, by reforms long delayed and urgently required.

But let us assure Sir Charles Elliott that, increased efficiency and cheapness will not be attained by dismissing clerks and chuprasees—or by subsidising a public organ to support individual hobbies. The whole question must be looked at from the point of view of a large employer of highly skilled labor, and the keynote of reform is individual responsibility, the setting of each class to do the best work it is fitted for, and entrusting it with the necessary powers.

We have no hesitation in saying that any private firm which should endeavour to transact its business as any one Superintending Engineer is compelled to do his, would be brought to ruin in six months. Or what shall be said of the wisdom of those who would keep an Engineer who has spent three years studying all the theory of his profession making bricks for 18 years, when a foreman brickmaker on Rs. 150 to Rs. 200 per month would do the work better, because more contentedly.

Reforms fall naturally into two classes :—(A) Those of Departmental procedure; (B) those of internal organization.

To take the latter first. The first measure is certainly the dismissal from all grades of the service of men who are notoriously incompetent, indolent or physically unfit. There are many of these. Not perhaps many as implying a large percentage, but probably about 10 per cent. These men would have no just cause for complaint if their services were dispensed with on the gratuity or pension due to their length of service, allowing liberal terms to the incapacitated. The unfortunate feature in the case, and the only drawback we see, is that the Secre-



tariat thinks apparently that a straightforward and public report, annually or half-yearly, of an officer's services, and the opinion his superiors have of him, is detrimental to discipline, and consequently many men against whom there are bad "confidentials," are kept in the dark, year after year, and go on steadily deteriorating when one sharp reproof at the beginning of their career would have saved them.

The next necessity is one which will cause the Finance Department to lift its hands in horror. It is nothing less than the grant of Staff Corps sterling pensions and complete equality with the Military Engineer. Nevertheless, we must come to this. The P. W. D. has been ruled not to belong to the Uncovenanted Service. It has been over and over again promised equality as between its Military and Civil members, and the expense involved in this recommendation would be repaid twice over in the increased efficiency of a smaller and better managed Department.

Thirdly, there must be devised some system by which highly trained men, appointed from England, are no longer left for years to repair *kucha* roads, re-plaster *serais*, make bricks, and perform the hundred petty duties of a foreman, and in doing which the worth rusts out of them. In other words, Government must cease providing razors to cut whetstones. Whether this is best done by the formation of a Provincial branch officered mainly by natives, statutory and actual, is at present a moot point.

Fourthly, it is certainly desirable to keep the number of officers in the Department at a permanently lower figure than at present; and this cannot be done without a change in the mode of departmental procedure in the execution of works to which we have before alluded, so as to leave each Executive officer much more time for supervision. In the first place, the present mode of Departmental procedure is terribly cumbrous and intricate in its details.

It is, of course, absolutely essential that Local Governments (for local works) and the Central Government (for Railways and canals) should have the most complete control of expenditure.

But once an undertaking is decided upon, and the necessary estimates have been submitted by the Engineer entrusted with their preparation, these should be criticised in comparison with the well-known cost of similar works elsewhere, and then the fullest freedom allowed to the officer deputed to carry them out. He must feel that his professional reputation and his Departmental standing alike are involved in their satisfactory execution within the estimated amounts. The English public, to judge by recent Royal and Parliamentary Commissions, has just awakened to the fact that duplicate copies of every letter written, counter-signatures to every petty item of expenditure, and a large staff of sedentary officials does not conduce to economy, but rather the reverse.

To take one single item. It has recently been ruled by Government order that no stores whatever of European

manufacture over the value of Rs. 10 are to be purchased even by Engineers-in-Chief or Managers of Railways. The practical outcome of this, as it affects work, is only delay, for no person can foresee his requirements of English stores down to such small amounts, and one of three things must happen: either the works are delayed while the materials are in transit and the offices are corresponding, or indents are made needlessly large to cover unforeseen requirements, or the rule is evaded.

If the India Office is unwilling (as doubtless is the case) to relinquish its patronage in favor of accredited Indian agents to European firms, let the functions of the Store Department be limited to the supply of the large indents for English stores, which it is the business of a controlling Engineer to prepare at the commencement of a project. For small stores and minor works, it is useless and wasteful to hamper the Executive officer with a procedure which no firm employing their own money would dream of using.

The Superintending Engineer should be permitted to extend the same principle of personal responsibility to the officers under him. It should be a primary duty with each Executive Engineer to verify the estimates he is called upon to carry out, and to stand or fall by them. No great changes in the administrative system, or in the forms dear to the Accounts Department are required. Some would fall into desuetude and into the limbo of things that never would be missed, but the majority would remain, being less frequently filled up. An officer aware that his prospects in life depended upon his ability to design and carry out the works entrusted to him efficiently and cheaply, more than upon his not transgressing any of the thousand and one rules embodied in Codes, standing orders and Government circulars issued for his guidance, would be far more likely to turn out good and cheap work than now, when he can escape all blame if he can shew that he has followed the Codes.

Personal responsibility, sharp, clear, and well-defined, is the desideratum; fewer hard and fast rules, and less uniformity of routine; smaller offices and fewer records—but more of the commercial and commonsense spirit which perceives that under a system of trust in well-bred and well-educated professional men there will here and there be losses which *perhaps* may not occur under the present system, but which are far out-weighed by the saving in time, money and efficiency, due to the full and useful employment of the large majority. It is this spirit, which looks to large results, not to small risks, which has brought, and still maintains, more than half the foreign trade of the world under our flag. The two systems are in the economics of their working not unlike Cash and Credit.

THE death of Richard Anthony Proctor, the astronomer, is announced.

THE highest railway in the United States is the Denver and Rio Grande, the Marshall Pass on which is 10,852ft. above sea level.

It has been decided that the terms of payment for cadres at the Royal Military Academy and Royal Military College who are sons of private gentlemen shall be £150 a year instead of £125 as heretofore.



## FAS EST ET AB HOSTIS DOCERI.

## I.

BETWEEN agricultural and trade depressions, and ever increasing inroads and pressures of competition, England's social and economic condition as a nation is lacking in cheerful aspects. Trade is worse than dull. Manufacturers, unable to find profitable markets for their wares, have all but stopped manufacturing; have—*à la mode* the Government of India, when it is seized with one of its periodical scares about national bankruptcy, gone in for reductions of establishment. Only their reductions are real, and sweeping, more concerned to save pence and pounds than with white-wash, and dissolving views that won't wash. Most of them have dismissed their employes wholesale, retaining only a few hands about their factories—*nam ke waste*, as an appropriate Hindustani idiom hath it, than for any more sufficient reason. The dismissed workmen, delighted with such an irreproachable justification for idleness, made the most of their ensuing good time, spent best part of it in pot-houses until the strain on Trades Union Benefit Funds had well nigh exhausted Trades Union Treasuries. They then began to think that they were hardly used, and lots of them wandered from the provinces to London, to swell the already swollen ranks of the disaffected there, and agitate for work and wages. The story of their mass meetings in the Parks and Trafalgar Square, of their traffic-obstructing street processions, of their defiances of law and conflicts with the Metropolitan Police, of the apprehension they established within respectability's borders, is written in the newspaper and records of the period! A shadow story of communist chaos threatening the high places of society, and frightening the middle places into extemporization of special constabularism and delirious appeals to the Home Secretary for protection. When public opinion arraigned the manufacturers for their share in the causation of this factiousness, they made answer that they were being undersold to a melancholy extent by German and French rivals; and to a far greater extent by the cheap outputs of American factories. That was and remains a fact, accounting for which is easy.

Workmen educated to handicrafts in the United States are, by virtue of that education, free-handed, quick-witted, skilled artificers. Uneducated workmen in the British isles are, for lack of such intelligent training, comparatively speaking, wanting in suppleness of thumb and fingers, in quickness of apprehension, in perfection of mechanical skill from such constituent elements educed. They are held too much in bondage by obsolete methods and antiquated designs to be successful in competition with modern applications of science and art to handicrafts. Overtaken by the Nemesis of disregard for these they have been pushed to the wall. They are as unable as they are unwilling to see their present situation in that light, and in spite of trade depression they want to be paid as high wages as they were equitably earning in the early days of the Free Trade Evangel, when England was Europe's empo-

rium for manufactures, and Continental nations were content to let England have undisputed monopoly of most of them. It was a condition uneconomic, quite too "too too," too millennial in its assumptions, too good to last—an inflation abnormal and fortuitous, foundationless, and uninsured. Development of Continental Railway systems gave it a first shrewd push on the road to collapse; fidelity to free trade dogmas insidiously helped to give impetus to the push. Conferring all the bounties of a free trade gospel on unbelievers who gave nothing in return has done much injury to British trade; but the British workman's stolid refusal to learn the lessons of the new industrial era has done far more. Wherefore, from him trade dominion has been taken, and given to plodding Germans and 'cute Yankees, and we find the patriotic Gladstone admitting the superiority of an American axe over an English axe for those tree felling purposes that are the business of the ex-Premier's life.

America has of its own motion, partly by its repudiation of Free Trade dogmas, but mainly because of the attention it has paid to practical, technical, handicraft education secured all the advantages pertaining to the state of what international treaties style "the most favoured nation" without, as English Chancellors of the Exchequer do, giving everything for nothing, and allowing the contracted for reciprocity to remain all on one side. America owes some of its prosperity to repudiation of free trade one-sidedness; but far more to the practical teaching given, at its educational institutes to embryo workmen, when they are in *statu pupillari*, supple-fingered, and ductile-minded. It is true that Harvard and Yale, the two colleges that loom biggest on the trans-Atlantic horizon, do but little to encourage practicality. But they are antiquated, out of count in the new era, although, like our English Oxford and Cambridge, they have their educational function of a different pattern and do justice to it.

The new State Colleges order their affairs differently, attaching great importance to technical instruction and practicality. In 1862 Congress passed an Act, by virtue of which any State desirous of having a College of Agriculture and Mechanic Arts was given a certain portion of State land as a nucleus for realization of its aspirations. No stinted valueless portion either. Support was contemplated as well as a building site where growth of brickwork was to supplant growth of breadstuffs. On one application being made, the University of California obtained a grant of 150,000 acres—good wheat land all. From these acres and a supplement of handsome contributions from Californians have been evolved, in connection with the University, Colleges of Civil Engineering, Mechanics, Mining, Chemistry—Practicality.

At a late meeting of the (American) National Education Society, a Californian delegate said of these in their collective strength, that he believed they branched outwards and downwards, and in their issues got nearer the people's industrial interests than unpractically conducted educational headcentres can. From its Agricultural Department bulletins are gratuitously distributed, giving



the results of scientific investigation and practical experiment as to matters of direct, practical value and importance to farmers, fruit-growers, and vineyard proprietors. In this connection the aforesaid Californian delegate remarked :—

The wine interests, now assuming such vast proportions in California, are not forgotten, and the University has a large fermenting cellar and all necessary appliances for thorough, intelligent, practical work, as well as scientific investigation and experiment. Some splendid and very successful experimental work is being done there also, in the direction of determining the character and values of ores by the use of the microscope. Indeed, in the department of mineralogy and metallurgy, I have been told by those who were in position to be thoroughly informed on the subject, that very few institutions anywhere are better equipped than our University. In addition to other large collections, those of the State Geological Survey, which cost the State Government hundreds of thousands of dollars, are now the property of the institution. I do not mean that it is rich simply in case specimens, but in hand specimens for manipulation by the students as well. Moreover, there is a fully equipped assay office, and a department, with all the mechanical appliances of mining, such as a quartz mill, crushers, concentrators, &c., where the student can see practical work carried on in the beneficiation of ores. Without detailing the practical work done in the Mechanical Arts College, or the Fine Art Gallery, the gift of Henry D. Bacon, or more than naming the library, enriched by gifts by many generous givers—indeed, in a word, without elaborating further, I repeat that the people of our State feel, that in the University of California they have, not only a place for their young men and women to go to for instruction in any branch of human knowledge, but that they themselves, from day to day, at their homes and in their business, can share in its advantages, and enjoy its blessings. Without at all yielding any of its strength or its dignity, it is made, essentially, a University of and for the people.

Almost all academical institutions in the States have scientific collections of one sort or another, and more or less completeness. American citizens have been able to see what few English educationalists have had faculty for seeing—to wit, that in the acquisition of knowledge words were never intended to take the place of things. When things, actualities are valued more than verbiage, the germinating youthful mind becomes conscious of knowledge, and of obtaining it by its own efforts. Under a system of objective teaching, the learner is brought in direct contact with whatever he is to know. In addition to objective study of "things," drawing is recommended as being specially adapted to training of eye and hand to skill and perspicuous usefulness. It is the language of form and may, on occasion, take precedence of speech, or writing, as an emphatic mode of expressing ideas. In short, it has the supreme merit of practicality.

#### THE ADMINISTRATION OF PERAK, 1887.

THIRTEEN years ago few persons, even in India, were aware of the existence of the native State of Perak in the Malayan Peninsula, until the murder of Mr. Birch a representative of the British Government, brought it into prominent notice towards the autumn of 1875, when a punitive expedition was sent against the reigning Sultan, and the State came under British Protectorate. The territory of Perak, which lies on the west coast of a tongue of land, stretching nearly to the Equator, contains mineral deposits, especially tin, exceeding in richness those of any other country in the East.

Some years back Larut, the subsidiary district of Perak, was administered by an enterprising man appointed by the then Sultan, who had made a fortune from the revenues of its tin-mines. Since his death and the succession of his son, all control over the Chinese was lost; they split into two rival factions, a series of disturbances took place and subsequent piracies, which led finally to the necessity for British interference, as the disaffection was spreading to Penang, Singapore and Malacca. The usual nostrum of appointing Residents and Assistant Residents to the Court of the Sultan to uphold his power and help him in preserving peace in his dominions, proved abortive; the treachery of the Sultan and his Chiefs culminated in the murder of Mr. Birch, followed by a miniature war and the establishment of a British Protectorate.

Colonel McNair, in his valuable work, "Perak and the Malays," describes the country as "so mild in climate, so luxuriant in vegetation, so regular in the succession of refreshing rains, so unvisited by storms that prevail in the East."

The geological formation of the Peninsula is described as granitic, overlaid most generally by sandstone, and frequently also by laterite or cellular clay ironstone, and to the north by limestone. The prevailing metals are iron, tin, and gold. Iron ores are found everywhere and in all parts where it is sought. All the tin ore heretofore worked has been found in the alluvian or detritus of ancient mountains—what is called in mining language "stream works"—obtained by washing the soil in the same manner as, for the most part, gold in Australia and California. During the last few years what British capital and energy, with the appliances of modern machinery, have done to develop the industry, which promises in the course of time to surpass the production of any other part of the known world, will best appear from a Report on the State of Perak for the year 1887, compiled by Sir Hugh Low, H. B. M.'s Resident, Perak.

The Revenue for the year amounted to \$1,827,476, shewing an excess of \$140,702 on the estimate (\$1,686,774) and an increase of \$139,200 on the amount collected in the previous year. The expenditure for the year having amounted to \$1,550,489, the receipts were in excess of payments by \$276,987. In this respect the Government of India might well profit by the example of the Financier at Perak, as our



estimates of receipts invariably exceed the amount actually received, and in the matter of expenditure, they as regularly fall short. Under the head of Revenue the receipts from the rent of Mining Lands Kwala Kangsa was \$549 below the estimate; while Larût, Lower Perak (Batang Padang) and Kinta exceeded them. The last by the large sum of \$4,155. The excess in the Customs' collections is due mainly to the larger amounts received as duty on tin and charcoal. The exceptionally high price of tin during the last half of 1887 greatly stimulated its production. There has been a steady progressive increase in this direction for some years past, from 88,143 pks in 1880 to 217,945 pks in 1887. The income from Port and Harbour dues shews an increase of \$19,078 as compared with 1886. This is due to the larger number of ships and boats which frequented both Larût and Lower Perak, especially the small ports of the former district. In Postal and Telegraph accounts there was an excess of receipts upon expenditure of \$1,225, shewing an increase in the receipts as compared with 1886 of \$2,092. There was a deficiency of \$4,923 on the work proposed to be done in the Public Works Workshop. The total expenditure, as we have said above, amounts to \$1,550,489, against an estimate of \$1,683,056, shewing a saving of \$432,567, and an increase over the expenditure of the previous year of \$85,164. In salaries and allowances to native Chiefs, there was expended a sum of \$103,884, being an increase of \$27,620 over the expenditure of 1886. The large increase was incurred to provide additions to the income of His Highness the Sultan, the Raja Muda and other Chiefs. The provision for paying the tithe on tin to the Chiefs of Kwala Kangsa and Kinta had been much under-estimated. In education there was a saving of \$5,137, estimated \$6,590, actual \$1,452, increase on previous year \$24. The estimate provided \$4,320 for the education of young Rajas, but as the late Sultan could not be induced to take any interest in the project it fell to the ground. The actual amount expended on Government vessels, was \$9,049, out of an estimate of \$8,100; there was a decrease on 1886 of \$25,235, owing to the purchase of a vessel called the *Mena* in that year. Under the head of Works and Buildings \$195,938 were expended out of an estimate of \$261,704 shewing a decrease, compared with 1886, of \$26,290. Under Roads and Bridges there were spent \$328,287, the estimates having been \$394,220, increase on the previous year \$14,401. The item of special payments includes \$6,115 for the celebration of H. M's Jubilee; installation of H. H. the late Sultan \$3,056; Sultan of Perak's contribution to the Imperial Institute \$6,400, &c. With a view to the protection of valuable timber destroyed by charcoal burners, a furnace called the "Ralow Tongka," in which the tin ore can be reduced by the use of ordinary firewood, was ordered to be generally used throughout the State. As we have already exceeded the limits which we had prescribed to ourselves for this article, we shall resume our remarks in our next issue.

## Notes and Comments.

**THE MADRAS HIGH COURT.**—Government have accepted rough plans and estimates, amounting to nine and half lakhs of rupees, for the construction of the new High Court buildings, which is to be proceeded with immediately.

**THE TRICHINOPOLY WATER-SUPPLY.**—The Madras Government has approved generally of the outlines of a water-supply scheme, to cost 2½ lakhs, proposed for Trichinopoly by the Collector and the Municipal Council of Trichinopoly.

**HORBURY'S PATENT LATRINES.**—The Chief Engineer, Public Works Department, Madras, considers that Horbury's latrine must be condemned. He says:—"It is certainly too hot for use in the plains, even if the arrangements were good; but these the Executive Engineers who have put them up consider objectionable."

**LORD REAY.**—The following excerpt may afford some explanation of the vagaries referred to in our remarks on the Bombay P. W. D. in last issue. "The truth is—and the truth is nowhere more openly told than in Bombay itself—that its Governor is a well-meaning muddler—a theoretically clever but practically dull man."

**PUBLIC WORKS AT INDORE.**—His Highness the Maharajah Holkar has allotted Rs. 50,000 for a new building to accommodate the civil and criminal courts, near the railway station, opposite to the cotton mills. The foundation-stone will be laid during the Dussera festival. The construction of public roads in Rampura and Nimad districts has also been sanctioned at a heavy cost.

**RULES FOR PROSPECTING AND MINING FOR GOLD AND OTHER METALS AND PRECIOUS STONES.**—The Proceedings of the Board of Revenue in regard to the rules in force for prospecting and for mining for (1) gold, for (2) other metals, and for (3) diamonds and precious stones, stating that they do not think that any modifications are called for in the Rules now in force, is endorsed by the Madras Government.

**A NEW CABLE PROJECT.**—The laying of a cable between Vancouver, Hawali, the Fanning and Fiji Islands, New Zealand, and Australia is in contemplation. The total distance to be conveyed by cable is 6,800 miles, but the longest single stretch of submarine cable is not to be over 2,000 miles. The project, it is reported, has received the hearty approval of all the colonists, who are anxious for the prompt laying of the cable.

**BENGAL COAL ON THE BURMA RAILWAYS.**—The Manager of the Burma State Railway has taken a tip from the Irrawaddy Flotilla Company who are gradually giving up burning European coal, and substituting Bengal coal. The Railway has accordingly indented for a couple of thousand tons of Bengal coal which can be landed at Rangoon at Rs. 15-10 per ton, while the European article is sold there at Rs. 26 per ton.

**DEOGHUR RAILWAY.**—The report of the managing agents for the first half of this year shews that the receipts were Rs. 13,324 and the expenditure Rs. 7,010, leaving a profit of Rs. 6,314, which admits of a dividend at the rate of 4 per cent. per annum being declared, and Rs. 814 being carried forward. The line has been well maintained, and is in good order throughout, and the passenger traffic shews a satisfactory increase.



**EXPENDITURE ON IRRIGATION WORKS, MADRAS, 1887-88.**—The total expenditure from Imperial funds amounted to Rs. 23,75,821 and that from Provincial funds to Rs. 26,23,377, the final grants being Rs. 24,45,061 and Rs. 27,10,000 respectively, 2·83 per cent. of the grant lapsed under Imperial and 3·20 per cent. under Provincial, the total lapse being 3·02 per cent. on the whole grant against 7·70 per cent. in the previous year.

**THE INDIAN GOLD MINES.**—The following are the results of the crushings of the Mysore mines during August.—Mysore crushed 1,504 tons which yield 1,350 ounces of gold. Nundydroog crushed 390 tons for 580 ounces. Ooregum crushed 255 tons for 533 ounces. The Consolitated crushed 325 tons for 200 ounces. Balaghat crushed 115 tons for 227 ounces. Mysore also obtained 87 ounces of gold from 370 tons of concentrated tailings.

**BEZWADA WORKSHOPS.**—The Papers exhibiting the financial results of the Bezwada Workshops for 1887-88 shew that the net profit for the year is Rs. 1,043-3-6, against Rs. 411-1-11 in the previous year, and is due to the value of outslabs disposed of, which brought in a considerable profit, instead of loss as in the previous year; these outslabs being now in demand for roofing out-houses in the new town. The value of work done during the year exceeded half a lakh of rupees.

**PROGRESS IN HONGKONG.**—Civilisation, as well as building, is making rapid strides at the Peak; which has now got a Lock-up, a Church, a Bell, a Tramway, a Hotel, a Club (in embryo). During the past seven years the Colony has got a Breakwater, a Dredger, a Dam, an Aqueduct (which also gives a fine road), a Tramway, a new Dock, a good Hospital, a new Bank Building, Fortifications, New Wharves, a Reclamation Scheme and New Praya, a light on the Gap Rock and steamers on the West River.

**EMPLOYMENT OF GOVERNMENT SERVANTS.**—The Government of India have finally set at rest the vexed question whether a servant of Government can take furlough and then accept service under another employer in India. The decision is that this cannot be done without the special sanction of the Government of India in each particular case, and that if, for special reasons, such sanction should be accorded, the officer in question must resign all claims to leave or furlough allowance as long as his private employment lasts.

**PHONO-STENOGRAPHY.**—As a great controversy is now being raised between the advocates of Pitman's Phonocism and Phono-Stenography, the lithographic pamphlet issued by A. F. B. at the *Spectator* Press, Bangalore, will be deemed germane to the matter, its merits having been already discussed in these pages. Considering that the author is fighting an up-hill battle against Messrs. Pitman & Co., with their rich vested interests of 40 years, while he is poor and unknown, he should elicit sympathy, or at least receive a fair trial.

**SOUTH INDIAN RAILWAY.**—The Government of India have sanctioned the transmission to England of an indent for either 25 ordinary third-class carriages, estimated to cost Rs. 62,500, or 12 third-class carriages on bogies with frames, 38 feet in length, estimated to cost Rs. 57,000, required to meet the additional passenger-traffic on special occasions. But we are not told which of the alternate estimates has been adopted, but we are disposed to think the "bogies," as the Consulting Engineer is in favor of this class of vehicle.

**MADRAS COLLEGE OF ENGINEERING.**—In his Proceedings on the last Annual Report on the Engineering College, the Director of Public Instruction remarks:—"The results of the College for the past year have been far from satisfactory, but it is hoped that the re-organization of the institution will mark a new era in its history, and that with the additional staff of Professors and its extended scope, and improved methods of operation, it will yet play an important part in the promotion of technical education in general and of Engineering in particular.

**TUNGABHADRA IRRIGATION.**—There are eight anicuts across this river from which channels are led for irrigation. The eight channels have a total length of about 102 miles; they are very tortuous, and there are numerous sluices. Most of them have no means whatever of regulation, and many are open cuts, and generally it may be said they are in bad order. In their present state it is impossible to regulate them in any satisfactory way. The three upper channels have head sluices, the others open heads, but it is said these head sluices are not worked properly.

**A SANITARY WANT.**—The Jankuli Khal and other impediments in the way of irrigating the Midnapore District are local improvements which fall within the scope of the recent Resolution of the Government of India on Sanitation. This is a subject about which applications have been made to the local Government from time to time, but no notice seems to have been taken of the representations of the people. Their grievances remain unredressed, but it is to be hoped the visit of the Lieutenant-Governor to Midnapore will result in some good being done to the parts affected by the inundation.

**A TRADE CATALOGUE.**—We have on a previous occasion referred to Messrs. P. Orr and Sons' specialities. The new catalogue of the same firm printed at the Lawrence Asylum Press at Madras is a credit to Indian printing. The illustrated description of the Weldon Range Finder, and of the Pedometer and Passometer on page 14 are worthy of the attention of the Profession. The "Refractometer described on page 15 is a scientific novelty, the value of which will be recognised both by the oculist and the optician. Among other good things we find the D. P. W. lantern too well-known by Engineers as the best lamps for the camp ever invented.

**PUNJAB MUNICIPALITIES: A COMPARISON.**—Lahore seems to be gradually dropping out of its position as Capital of the Punjab, as much owing to the supineness, indifference and ignorance of its Municipality, as any other causes, while on the other hand, Pindi and Amritsar are running it close in that respect, mainly owing to the go-aheadness of their Municipalities, piloted by two such energetic and practical Secretaries as Mr. Judd and Mr. Nicholl. We learn now that it is contemplated to light the whole of Pindi with gas, and that a sum of money has been voted to the Gas Engineer of Bombay to draw up plans and estimates for a feasible scheme.

**THE SHONE SYSTEM OF DRAINAGE.**—The *Sind Gazette* says there can be no doubt that Karachi is badly in need of a thorough system of drainage, since the introduction of the Mulleer water. Our contemporary hears that Mr. Ault intends giving Karachi a visit in connection with the Shone system of drainage, when it hopes he will explain the system to the Municipality, and that they will come to some conclusion as to the desirability of



otherwise introducing an efficient system into Karachi. Rangoon will probably be the first Eastern seaport to introduce the Shone system, which will probably be in working order by 1890, and we trust will prove as successful as it has been in England.

**WEST COAST CANALS.**—The Travancore State is now improving the canals between Quilon and the Cochin frontier, and contemplates steam communication over this portion of the back-waters and canals, at an early date, and if the British and Cochin authorities improve the canal between Kampadanam and the Trichoor lake, it seems probable that a Railway line to connect the canals with the Madras line, is likely to be directly remunerative. It is advocated that a line of the same gauge as the Madras line, and arrangements be made with the Madras Railway Company to run their stock upon it, even though the branch be constructed by the Cochin State, and by the Cochin Engineers.

**IRRIGATION OPERATIONS IN BENGAL FOR RABI, 1887-88.**—The area irrigated during the *rabi* season of 1887-88 was 61,653 acres against 49,381 acres in 1886-87, shewing an increase of 24·8 per cent. In Midnapore no canal irrigation of *rabi* takes place owing to the insufficiency of the water-supply during the *rabi* season. In this district, as in Hooghly, Cuttack and Balasore, the area under *rabi* cultivation is insignificant. The increase occurs almost entirely in the districts irrigated by the Sone canals, the return from Gya alone shewing a trifling decrease. The Sarun canals also shew an improvement. These better results were due to the short rainfall in the four Behar districts where irrigation takes place.

**THE O. AND R. RAILWAY.**—It is announced that the fate of the officers of the O. and R. Railway, on its becoming a State Railway, has at last been decided. Government have offered the following officers appointments:—Mr. Sydney Hartwell, as Traffic Superintendent of the Railway; Mr. Muirhead, as Assistant Traffic Superintendent; Mr. F. G. T. Walton, C.I.E., Resident Engineer, Benares; Messrs. Rogers and Sim, Assistant Engineers; and Mr. Moore, Assistant Locomotive Superintendent. In regard to the other officers, Government have offered to relieve them at once, giving them pay to the end of the year, and bonuses on much the same lines as the retiring officers of the late S. P. and D. Railway.

**RAILWAY ACCIDENTS IN INDIA.**—Compared with the average of the five previous quarters there was in the last quarter of 1887 a decrease of 64 in the accidents to trains, rolling stock, permanent way, &c., while there was a large increase in the number of miles opened and in the train mileage. The total number of accidents was 564 as against 627, of which only three were fatal. From causes other than accidents to trains, 14 passengers were killed and 26 injured, while 35 railway servants were killed and 103 injured. In addition to the above 14 persons were killed and 26 injured in the yards and workshops; and 100 persons met their death in carriages and at stations from causes unconnected with the working of trains; while 55 deaths are classed as either those of suicides or of trespassers on the railway lines.

**CIVIL BUILDINGS IN UPPER BURMA.**—Plans and estimates for courts and offices at Mandalay have been prepared and the work commenced. Courts for the head quarters of districts are under construction at the following head quarter stations:—Bhamo, Shwebo, Sagaing,

Kyaukse, Mònywa, Yaméthin, Pyinmana, Myingyan, Pakòkku. The estimated cost of the courts is Rs. 23,000 each. Except at Sagaing, Shwebo, and Yaméthin, it has not been found possible to provide funds for building more than half the court-houses in the current year. District court-houses, affording somewhat less accommodation, have also been built at Pagan and Minbu. Subdivisional court-houses have been built at the following places at a cost of about Rs. 3,700 each:—Tigyaing, Myinmu, Kindat, Meiktila, Yaméthin, Napé; and are now under construction at—Shwegugyi, Myedu, Mogòk, Salin, Wundwin. In addition to the above temporary courts have been built in very many places.

**RUBY MINES ROAD.**—The hill road from Thabeikkyin to Bernardmyo, a distance of 60 miles, has been laid out and the first 50 miles have been opened out to a width of 12 feet excavated from the hillside, and all the major and most of the minor streams have been bridged, so that carts were running to within 12 miles of Bernardmyo before the rains commenced. Carts will not be able to use the road during the rains till the road is metalled, but for this funds are not available. The 10 miles that remained to be done to open the road through offer no difficulties, but the hill labour has gone off to the cultivation of fields, and Burmans from the plain cannot be induced to go up to work in the hills. The cost of the road to date has been about Rs. 3,00,000, which includes about Rs. 50,000 spent by the Military authority on mule-roads. The road to Mogòk will take off about 13 miles from Bernardmyo, and the branch will be about 20 miles long and will cost about Rs. 100,000, unmetalled.

**THE GANJAM IRRIGATION SCHEME.**—Early in the year, 1887-88, owing to the reduction of establishment and scarcity of labor, it was apprehended that great difficulty would be experienced in working out the budget grant for the Rushikulya project. A sum of Rs. 73,800 was, therefore, surrendered. But later on in the year, when the executive staff of the division was strengthened and labor was more abundant, the works were carried out vigorously. Compensation for the lands required for the project was settled and paid more expeditiously than was anticipated. The expenditure on works, therefore, exceeded the grant by Rs. 7,990, notwithstanding the additional grant of Rs. 25,000 obtained by a telegraphic application to the Government of India in February last. The expenditure on tools and plant required for the project was more than double the grant, 13,387 running feet of rails for laying down a tramway at Gumsur anicut having been obtained from the Nellore Division and two steam derrick cranes from the Public Works Stores.

**“A SUGGESTION.”**—On this a correspondent writes:—The usefulness of the Schools of Art in India is now seriously marred by the circumstance that students are not trained for the special needs of the Engineers, Whether Public Works or private practising on their own account, Engineers care little for highly finished artistic drawings, such as are mostly turned out by the School of Art students; while they are most deplorably, but, we must add, justly indifferent to artistic chiaroscuro, and classic or other curves, of the female form divine; they need men who will draw plain but absolutely accurate line drawings, of bridges, buildings, or machinery from measured sketches, or from actual examples; who will be able



to "plot" a series of levels, or a survey from a field book; and who will occasionally be able, at a pinch, to use the compass and plane table. These useful things are, however, just exactly the things that are not taught, we fear, in the Schools of Art; and, of course, without these the whole of their other accomplishments are as regards the professional Engineer or architect, vain.

**IRRIGATION WORKS IN UPPER BURMA.**—Very little actual work has been done under the head "Irrigation," but endeavours have been made to discover what systems of irrigation are in working order and how far others can be repaired by a small expenditure of money. The most important works that have been carried out have been—

(1) repairs and improvements to tanks and channels in the Mandalay district;

(2) repairs to weirs in the Kyauksé district;

(3) repairs to tanks and channels in the Ye-u district;

(4) repairs to the Mu bund and construction of a masonry overflow to the Mahananda lake at Shwebo by which the capacity of the tank will be increased at least fourfold. Some information has been collected concerning the Kyauksé irrigation which will, it is hoped, result in the weirs being thoroughly repaired in good time next cold season, and in the amount of water entering the head of the canals being regulated so as to prevent breaches where there is excessive water in the river when in flood. In Shwebo surveys have been made with a view to the restoration of the very extensive irrigation works in that district which are now entirely out of repair.

**IRRIGATION WORKS IN EGYPT.**—The British Vice Consul at Alexandria states that the irrigation works undertaken by the Public Works Department are yearly redeeming large tracts of land, and rendering them fit for cultivation. In Upper Egypt, where irrigation by means of the basin system has been adopted, much is being done to improve the regulation of water passing from one basin to another, and a system has been introduced by which the excessive rising of the level of the river when the draining of these basins takes place is prevented. The Nile is being gradually trained year by year, and spurs and other forms of protective works are made which tend to prevent the river from eating away its banks. Large areas of land have been destroyed by erosion; but it is hoped, that in time this will be entirely stopped, and the Nile made to flow within fixed limits. The most important work during 1887 was the repairing of the Barrage, the floor of the western part having been already raised and lengthened. New canals and branch canals have been commenced, and old ones repaired, and large sums have been spent on the extension of drainage works in the Delta. The improvement of the drainage has not only rendered large areas fit for cultivation, but has prevented others from deteriorating.

**INDIAN INDUSTRIES.**—In 1886-87 there were 89 cotton mills at work in India, containing 16,736 looms and 2,190 spindles. They employed an average daily number of 72,169 persons, and consumed about 264 million pounds of cotton in the year. Probably the whole capital invested in this industry is one thousand lakhs, or, at the conventional rate of exchange, ten millions sterling. Of the 89 mills, there were 67 in the Bombay Presidency, 49 of these being in the town and island of Bombay itself. The number of jute mills in India at the close of the official year 1886-87 was 24 (all of them but

two being in Bengal), employing a daily average number of 49,015 persons; the number of woollen mills was four; and the number of paper mills was nine (five in the Bombay Presidency, two in Bengal, and one each at Lucknow and Gwalior): 4,317,724 gallons of beer were brewed in India during 1886, of which nearly half was bought by the Commissariat. In 1886 there were 68 collieries being worked, and the total out-put from the mines was 1,388,487 tons. The total value of the foreign trade and shipping of India has grown from £14,342,290 in the year 1884-85 to £163,021,303 in 1886-87, this increase being more than eleven-fold, and shewing on the average an advance of 19·6 per cent. annually.

**NAVIGABLE CANALS IN MADRAS.**—The Secretary of State considers the water ways of Southern India unremunerative. The objections of Lord Cross are well met by Colonel Mead, who submits, that "we ought not to look for a direct return on navigation works in the Godavery and Kistna deltas, but should look to the return on all the works, irrigation and navigation together," and "the success of the irrigation in these deltas is chiefly owing to the cheap means of carrying away the produce afforded by the canals, and were it not for the canals, the revenue received from the irrigated land, and also that from unirrigated land and from other sources of revenue in the districts would not be so great as it is." The indirect returns to Government from these canals is thus very great, "much more so than from roads and bridges; &c., from which no direct return is asked for or expected." The net revenue from the Godavari system, comprising both irrigation and navigation works, in 1887-88 was 7·74 per cent. on the capital outlay, direct and indirect, the estimated ultimate return is 9·3 per cent. On the Kistna the return was 6·88 per cent.; the estimated ultimate return is 8·38. As to the Buckingham Canal, we are told that this is a protective, and never was expected to be a paying work; and we have it on the authority of the Chief Engineer that "it has realized all that was expected from it."

**BOMBAY PORT TRUST DREDGING PLANT.**—Until this year the Trustees' Dredging Plant consisted of the *Teredo*, a vessel of 638 tons O. B. M., and three attendant hopper barges, each capable of carrying 462 tons. The cost of the dredger and hoppers was Rs. 6,61,111. There was, besides, a small Priestman's dredger intended for work close to the Dock walls. During the past year two new dredgers have been received—the *Kuphus* and the *Pholas*. The former is a vessel of 1,000 tons capacity, and cost Rs. 4,44,467. The latter has a capacity of 500 tons, and is filled by two cranes carrying buckets of 40 cubic feet capacity; the cost was Rs. 1,77,257. The cost of work done during the year by the several dredgers varies considerably; that by the *Kuphus* 1·40 as. per ton, being the cheapest; next, the *Teredo* and hoppers at 2·07 as. per ton; and last the *Pholas* at 3·9 as. per ton. On examining the past records of the *Teredo*, it is found that her lowest rate in any one year has been 1·51 as. per ton in 1886, and that the average for the eleven years she has been working is 2·15 as. These rates include all charges except depreciation and interest, and it can hardly be expected that the *Kuphus* will maintain her present low rate when she comes to require repairs. The cost of the *Kuphus* being only two-thirds that of the *Teredo* and hoppers, there will be a constant saving in interest and depreciation which, as already stated, are not included in the foregoing returns.



## Current News.

THE high level Railway through the Bolan Pass has just been completed.

SEVERAL flour mills in Bombay have stopped working owing to the rise in the price of corn.

THE Western India Fine Arts Exhibition was opened at Poona yesterday afternoon by Lord Reay.

Two Royal Engineer officers are to be attached to the Sikkim Field Force, one being Captain Stanton.

It is reported from London that the question of the Burma Ruby Mines has at last been settled. But this report is otherwise contradicted.

A PROPOSAL has been submitted to the Madras Government by the Board of Revenue to hold an Agricultural Exhibition at Madras in April 1890.

THE Railway Conference, which is now sitting at Simla, will be fully occupied till the end of the month, so many are the subjects to be discussed.

MR. JABEZ LIGHTFOOT, Manager of the North-Western Railway, Sind Section, has been appointed Auditor of the Oudh, and Rohilkand Railway.

LIEUTENANT BEEVOY, R.E., Assistant Engineer, Htigyaing, Upper Burma, was found murdered in his bed on the night of the 14th instant. Nothing more is known of the sad affair.

THE Boiler and Factory Acts are to be at once instituted in the Berars, and every Mechanical Engineer is to possess a certificate of qualification before the next busy cotton season.

COLONEL HASTED, Chief Engineer and Secretary to Government P. W. D., Madras Member of Council, takes six months' special leave, Colonel Mead, the Joint-Secretary, acting for him.

THE telegraph line in Ceylon to Avisawella has been completed, and was opened to the public on the 1st instant. It is hoped the wire will be extended to Rutnapura and thence to Haputale.

It has been finally settled that the repairs to the Coconada Iron Girder Bridge shall be entrusted to Messrs. Burn and Co., of Howrah, the estimated cost of the repairs being Rs. 39,000.

MR. W. BEACH CAMPBELL, Assistant Engineer, 1st grade, is appointed Personal Assistant to the Superintending Engineer, First Circle, with effect from the forenoon of the 28th August 1888.

ORDERS have been issued for the laying down of a temporary line of telegraphic communication between Huripur and Derband. The telegraph section of the Bengal Sappers and Miners will lay and work the line.

It is stated that when Colonel Conway-Gordon takes four months' leave in November, he will utilise part of the time in a visit to America, to see all the principal Railway lines there, on behalf of the Indian Government.

THE proceedings of the Railway Conference are to be, as far as possible, quite private; but we are informed that practically the only subject of general public interest to be discussed, is the question of having only upper and lower class carriages on passenger trains.

THE works at Lundi Kotal are progressing rapidly. A large number of smiths, masons, and carpenters are now employed to finish the work under the control of Malak Khwas Khan, an Afridi of the Khyber, who appears to have taken the contract to complete the work within a limited period.

IN spite of the heavy rains the work on the Bengal-Nagpur Railway is making satisfactory progress. The largest bridge on the Raipur-Bilaspur section—the second crossing of the Seonath—has been completed, and will be opened about the 15th proximo. The structure is one of 14 spans of 150 feet.

## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*

## AN ACKNOWLEDGMENT.

SIR,—I beg to express my thanks to Mr. John C. Trautwine, Jr. &c., for the information he has been so kind as to supply regarding the tables in Molesworth's Pocket Book.

X.

## THE FAILURE OF THE KALI NADI AQUEDUCT.

SIR,—With reference to Mr. Mitra's letter inserted in your Journal of the 1st instant, regarding the probable discharge of the Kali Nadi River, I cannot help feeling convinced that the writer utterly fails to see that there can be any element affecting the discharge from off any catchment basin other than the "Drainage Area" and "rainfall in 24 hours."

The case of the Kali Nadi River is, as I understand it, a special one, and even a peculiar one, and cannot be dealt with in an off hand way. A mere reference to Colonel Dicken's formula  $D =$

$c\sqrt{M^3}$  (where  $c$  is a constant varying from 400 to 1,000, and

$M$  the drainage area in square miles) is not sufficient. To apply this formula, all the conditions or facts on which it was based must be known, and then only can it be applied with any degree of accuracy to the ever varying conditions of river basins that come before us. I think the letter under reference anything but conclusive argument as to the inadequacy of the waterway now provided for the Nadrai Aqueduct.

I do not now dispute his figures, because I consider that all the data which is absolutely necessary to enable one to calculate the discharge properly has not yet been furnished, at least in any document that I have perused on the subject.

TANSA;  
September 9, 1888.

E. C. HAWKES.

## "A GRIEVANCE"—DISCOUNTED.

SIR,—In one of your latest issues I had the surprise of perusing a letter under heading "Grievance" moving the Dewan to H. H. the Maharajah of Mysore to grant Sub-Division allowance to upper subordinates entertained or promoted after the rendition: which means levelling them up with their brethren who joined the Department when the Province was administered by European officers.

It would appear that these gentlemen advance their claims on score of long service, and the sequel would shew how far they deserve the emolument, cut down by a statesman, like Mr. Rengacharlu: and even a casual observer at the present constitution of this branch of service (with a very few honorable exceptions) would simply laugh at the very idea of these men.

Prior to the rendition, there were overseers from the Imperial Service, many of whom refused to serve under native administration after the Province was restored: it was then found necessary to fill up the vacancies (caused by the retirement of these officers) from the lower branch, which contained very raw materials, more than 50 per cent. of the same being recruited from the quill-driving class—i.e., they were Sub-Division clerks or writers in some Forest Office. The fund of knowledge which those recruits may have had, can be easily imagined, and it was below the average level, particularly in surveying and engineering: nay there are some sorry specimens who do not, even to the present day, know how to hold a drawing pen, much less to keep a field book: some of these have by their inaccurate levelling caused ruinous injury to the public: instances are not wanting to exemplify the above. So much to their theoretical or practical attainments. Turning to their "morale" it will be found that it is still more gloomy, but the less said on that head the better.

HARIHAR,  
September 4, 1888.

ONE WHO KNOWS:

## CHOICE AND CHANCE.

SIR,—There is, it seems, a mathematical "law of error" dominating banking operations all the world over. So, at least, the Journal of the Royal Statistical Society for March says, and waxes quite poetical over the notion, averring that the rules of chance "apply to the many dimpled undulations of commercial fair weather rather than to the solitary earthquake wave of a great crisis." It is a pretty idea, and may help to console fair weather bankrupts for their inefficiencies. Such people will do well, however, to bear in mind that this indulgent law of error "is fulfilled with various degrees of perfection." They might chance to get on its imperfection side, and that might prove as awkward a situation in its way as Mr. Morris's hero found his to be, when he got east of the sun and west of the moon.



The many dimpled banker is next compared to the manager of a club, and is supposed to undertake the supply of dinners to as many members thereof as choose to present themselves with prandial inclinations at the establishment he presides over. Here is the mathematical theory of banking from that point of regard:—

The modulus or measure of fluctuation in the sense above explained was found to be about 8.5. Accordingly it might be reckoned as about 100 to 1 that the excess of diners above the mean 18 would not on any evening exceed 13 (that there would not be more than 31 diners), and about 400 to 1 that the excess would not exceed 17. The manager might keep provisions upon the premises up to the first limit; for the less probable category of events he might provide in some other fashion, *a.g.*, for instance—as happens, I am told—by stinting the waiters, sending some of them who usually dine upon the premises to get their dinner elsewhere. And should the very improbable occur, he might have to resort to some heroic measure—such as borrowing from neighbours.

The theory of “the mathematical theory of banking” concludes with these words:—“The theorist must not pretend to wisdom if he knows so little what he is about as to mistake his abstract formulæ for rules immediately applicable to practice.”

“HOYLE.”

### THE PROPOSED WESTERN BENGAL RAILWAY.

SIR,—F. P. says in your paper of the 15th September in “the evidence given before the Committee of the House of Commons appointed in 1884,” &c., that as far back as 1850 the route was surveyed and levelled, and the distance saved ascertained to be 67 miles. I do not know which of the surveys are here alluded to, in 1847 I was connected with one of the survey parties, that ran a line along the Grand Trunk Road route. It was a reconnaissance survey with flying levels. Now the difference between a reconnaissance and a *pucca* location is very great. On the Benares Cuttack Railway the reconnaissance shewed certain success. Two years of location proved the line to be F. P. “flowers that bloom in spring;” but in place of their having nothing to do with the case, they have every thing to do with it. It is not the *sinuosities* of the ground alone that have to be dealt with, but they are flowers that spring from the same tree,—the highlands of Hazaribagh—ascend 900 feet descent 900 feet, the same coast line as baffled the surveyors who tried to ascend near Ranchee, and again near Keonjhar. I would have to write a chapter on geology to explain myself clearly, but the level of the great coast line barrier is first between 620, above sea level, and 760 feet; between the last and 1,200 feet above sea level there is an easier coast line, but still with a steep gradient for about 5 miles.

It is not the *sinuosities* alone that present difficulties—Engineers could afford to be patient over the *sinuosities*, but it is the heavy bridging and the gradients, that present difficulties in construction and working. The Western Bengal project has quite enough of bridging—more than enough; the Grand Trunk Road line will cap it in gradients. In 1847 we were all very enthusiastic about our short cut to Benares; we were pioneers, going to develop the resources of the highlands of Hazaribagh. I believe I was the only one who had been up and down the valley of the Ganges, before that time; however, the enthusiasm was so great that we all had Benares on the brain. But the Honorable East India Company just chucked all our projects aside, and got another Company called the E. I. R. to run the Loop line, which would tap the Ganges and serve Beerboom, Murshedabad, Bhagulpore and Behar. I soon came to see the wisdom of the measures taken by Government. I have been along the Grand Trunk route of late years, and would say that between Burrakar and Shareghauty very little traffic would be obtained except in coal; the highlands import a large quantity of food in exchange for jungle produce.

I do not suppose the coals that would be taken down from Western Sonthalia would do more than run on equal terms to Calcutta, against Raneegeunge and Burrakar. I must inform F. P. that the coal crop on the west of the Dominikoh hills runs as far south as Sooree. The Bhagulpore Nones project is about the eastern boundary of No. 2 trough of coal which is over 40 miles in breadth, and would have the Chord line E. I. R. between Burrakar and Luckee Serai as its western boundary. The coal trough may go 10 miles further west. The northern limits are well defined, and are about 24 miles south of Bhagulpore, and 30 miles south of Luckee Serai, the Western Bengal project will run through this trough diagonally, and compete on equal terms with the E. I. R. Raneegeunge, Burrakar or Giridoo have nothing to fear from competition in Sonthalia. But it is Palamow that will come into competition in the Northwest, and the Goomanee Valley coal will run into keen competition for the Ganges trade in coal, besides the 80,000 tons of coal that are required by the Eastern Bengal, the Northern Bengal and the Behar Assam lines.

I may mention here that I have made an estimate of the saving that would be made by Government after setting aside As. 8 a ton royalty, to pay interest on the 14 lakhs of rupees for a branch line from the E. I. R. loopline to the coal mines. The difference of saving to Government State Railways on 78,000 tons, would be about Rs. 250,000. If this is not inducement enough to rouse the Bengal Government to make an enquiry into the subject, then

I will bid the Bengal Government go and cultivate the *sinuosities* of the Hazaribagh highlands, so that when the Grand Chord line does run there, the trains may find a good supply of country produce to carry.

P. BURKE.

### ART IN INDIA.

#### II.

SIR,—It is not necessary for a pupil to know the French language or speak it; he could nevertheless follow the course of the studies during five years, and become a good decorative painter. The fees yearly are 300 francs.

The students who desire to enter the “Ecole des Beaux Arts,” and to pass the examination required for this object, could go to Mr. Julien's Studio, a private institution not under the dependence of Government, and where students of every age and nationality are admitted for studying drawing and painting, the “Ecole des Beaux Arts” admitting only good draughtsmen on the figure.

The Julien Studio is under the direction of four of the best masters in Paris: Messrs. W. Bongerueau, Tony Robert, Fleury Boulanger, and Jules Lefebvre. They advise and criticise the works of the students. This studio contains a very large number of pupils being a liberal school, which admits all ages; whereas at the “Beaux Arts” the limit of age is 30 years, over which students are to leave. At the Julien Studio, you have to draw from the cast after which you rise to upper section rapidly, where anatomy perspective and modelling are taught.

Considering such facilities of learning offered to young artists, in Paris, it would be desirable that the Government of India should introduce into each school of arts of the various presidencies, some competition prize, which will enable the successful candidate to be sent to France at the State expense, and even to receive from the same a small annual grant that will enable the young man to follow artistic studies either at the school “des Beaux Arts” or at private studios—in a word to do for the School of Arts of Paris what is done for the S. Kensington Academy.

If not in ten years, certainly before another century has passed away, the Hindoo artist will be able to see the light of the present system of art. In copying and following the principles of his predecessors, he will never come to the front; he must cross the seas and judge by himself the arts in a civilised country. I should not advise the young student to go first to England unless for a definitive object; but if he desires to improve his knowledge in drawing, portrait painting, architecture, modelling, and decorating, let him come to Paris, and turn a deaf ear to those who will warn him that he will lose the character of his Hindoo art. France itself now is the country which after Italy has the best collections of ancient and modern sculpture, and an immense number of pictures by the best artists.

After leaving the School of Beaux Arts, the student could go to Italy and study Michael Angelo, Raphael and others in Rome. This study will perfect him. But the young artist has to nerve himself against losing faith in his professional studies; it will take perhaps 20 or more years before reaching success: and he has not to listen to people who would try to discourage him, and even may call him a fool. The best way of overcoming discouragement, is to work together with a hundred, or so, of downright hard working men, in the same studio, men of whom the constant tendency is to excel in art.

The French studios in Paris, or “Ateliere” as they are called, are particularly apt to entertain in young artists the courage and will needed; the French, as I have found by experiment, are the best for that *esprit-de-corps* which takes you out of yourself; in a short time you will understand them, and see the things in their proper light.

An artist must not think that still life painting, as it is done in the Madras School of Arts, is the highest kind of art; some who are good at that kind of work, will tell you that if you can paint a jug or a copper vessel, you may consider yourself as a good painter! In fact you do nothing else, and all the Academical study that you go through in the Madras School of Arts, is to paint the pots and saucepans to be found in any kitchen. Certainly you will afterwards paint portraits, but how can you make these portraits living on the canvass if you had only studied still life? Still life painting requires certainly that you should put in it some dose of “spirit” and compose with good taste, but this requires to compare things together, and could only be obtained in Europe, at looking at the works of the masters of the arts.

In India such facilities are missing; the general outlook of an artist in India is a hopeless one; he is generally looked on with little favor; the country, however, is naturally artistic, but if art had not been in existence elsewhere, it would have never been seen in India.

I have seen some of my countrymen's paintings at the Indian and Colonial Exhibition in London, two years ago. They were not bad, but I could not put them to rank in any way with European works, and for many reasons. I do not mean to say that those who did them are undeserving any credit; far from it, I think even that deprived as they are of all means of comparing, they deserve more than if they had been Europeans. I know the works of Cavilapooram of Travancore, and those of Pestonjee Bomanjee of Bombay, but how different would have been the results of these men if they had come over to France to study, only for five years? It is not, however, too late. Let them come over, and show the



way as I did myself. I am sorry to say that I have not had the pleasure of meeting here any of my fellow students of the "Madras School of Arts." Some of them, however, were persuaded by me, and would have followed, but I regret to say, that they were not capable, at that time, of taking up a higher class of studies, for the reason that the "Madras School of Arts" had no regular life class, which is indispensable for figure drawing or painting.

In conclusion, it could be said that the course of drawing in Madras should be altered, and proper means afforded to the students for the future; and then only they will have an opportunity of producing good works.

No one can compose or draw with any feeling, if he has never studied the figure in his training. All the great artists are of this opinion here. There are no ornamental decorations, or fillings without figure in them, or if such they would be considered very poor.

But to finish and condense all the above, I will say:—

As the Hindoos have no chance of becoming real artists as long as they remain in India, let them come to Europe, especially to Paris, where living is cheap, and where every facility and encouragement will be offered to them.

PARIS; 1888.

TIGER.

### THE CALCUTTA PORT TRUST.

SIR,—I have read your article on the Calcutta Port Commissioners' Report for 1887-88, and while endorsing some of your views thereon, I beg to offer some remarks on the subject. The Report informs us that during the year for which an account is rendered rapid progress has been made with the construction of the Kidderpore docks. The total sum expended on these works up to the 31st March 1888 is Rs. 84,58,536; or 37 per cent of the total estimated cost, which amounts to Rs. 2,27,59,000. The percentages of the whole quantities of the two leading items of work done are, Earthwork 31·7 per cent, Brickwork 30·3 per cent. As the work already done is chiefly in foundation, and consequently the most costly the general agreement between work done and expenditure incurred may, as you say, be considered satisfactory. The quay walls of Dock No 1 have been founded for a length of 4,050 feet, or 62·9 of the whole, and 49·8 per cent of whole quantity of brickwork has been laid. Excavation of the boat canal has been pushed on, and 45·8 per cent of it has been finished. The lock, over-bridges, and drainage culverts will be undertaken next season. The portions of the scheme on which little or no progress has been made yet are the 80 feet entrance, the double passage to dock No 1, and the graving dock. It was impossible to proceed with these works until some progress had been made with the others in hand. No orders have been received from Government with regard to the canalization of Tolly's Nallah. If this work is not to be carried out arrangements must be made for putting in a lock.

The statement of the Port Trusts' Income and Expenditure during the last five years; i. e., since 1883-84 the year when Government made over charge of the Port to the Commissioners, does not adequately represent the measure of the Commissioners' financial well-doing. It has to be taken into account moreover that when in 1881 the charge of maintaining all Calcutta Port Approaches Establishments, Light-vessels, Light-houses, Buoys, and Survey-vessels was transferred from Government to the Port Trust, the Commissioners received, with these duties, the income derived from a Port Due levied on all vessels entering the Port at a rate of four annas per ton. The Commissioners' policy was to lessen this charge against shipping, already burdened with heavy pilotage charges: and with that view they reduced, from time to time, the rate of the Port Dues, and applied their surplus revenue towards meeting the cost of maintenance of Light, Surveying, and Buoyage establishments. During 1883-84, throughout the year, and for two months of the following year, the Commissioners' income was credited with the proceeds of a Port Due at a reduced rate of one anna per ton on all vessels entering the port. The value of this one anna Port Due to income was then calculated at Rs. 83,623 per annum, and the Port Dues having been abolished entirely in 1884-85, the effect of the voluntary surrender of this source of income was to decrease *pro tanto* the receipts of subsequent years.

Moreover the large increase in expenditure of Rs. 2,22,587 is mainly due to the fact that money has been appropriated to credit of the Port approaches Depreciation Fund, so that ways and means may be provided to pay for the new light vessel ordered after the cyclone of May 1887, which has been built and sent out by Messrs J. S. White, of Cowes, and is reported a most satisfactory piece of work.

Besides this, a sum of Rs. 1,64,530 taken from surplus-revenue has been employed upon works designed to improve or supplement existing appliances without bringing additional revenue. It obviously would not have been sound financial policy to pay interest on a loan contracted for unproductive, no-profit-yielding, works.

If there has been increase of expenditure we have also to note increase of income from the jetties—substantial increase aggregating Rs. 1,33,585.

The Budge Budge Wharf too has secured a large sum for storage of petroleum. So has the new Tea Warehouse for storage of tea. But this warehouse although providing great convenien-

ces for the accommodation of an important branch of trade has, it seems, led to interference with vested interests—other warehouses that is to say and to local dissatisfaction and unpopularity.

I must confess that my sympathies are with the "vested interests." I fail to see what right Port Commissioners have to interfere arbitrarily with the free course of trade for the mere satisfaction of unduly exalting their horn of righteousness. In all other respects their report is satisfactory: their purely engineering work seems to have been particularly well done, and there can be no doubt that they have conferred substantial benefits on the shipping frequenting the port.

FREE TRADE.

## Literary Notices.

### REPORT ON THE CAWNPORE AGRICULTURAL FARM—1886-87.

MIR MUHAMMAD HUSAIN, M. R.A.C., was in charge of what is officially called the Cawnpore Experimental Station for the season of 1886-87, and has submitted to the Agricultural Department a Report thereon, which now lies before us. We presume that experimental station is official language for—the model farm. At any rate, the Deputy Director seems to have been doing a lot of patient work in connection with experiments in crops, and agricultural operations. It is in such a way only that fairly accurate deductions can be made, any safe approach to authentic conclusion arrived at.

The India Office, which insists on sending supplies to all Indian departments, and generally bungles the business, sent out English wheat seed, which on arrival at its destination was found to be in bad condition.

It would be far better to stick to Indian wheat seeds. There are many local varieties; some of them excellent; all of them probably more suited to the exigencies of the soil and climate, than any that could be imported from a temperate zone. Moreover the people will be found to take to them more kindly than to foreign varieties; for they are naturally conservative. What is wanted is interchange of seed between different districts and the improvement in the quality thereof to be derived from a spreading abroad of the lessons of scientific culture. One local sample was, it seems, introduced. It is called Bazar; and the Director thinks it "appears likely to compete successfully with the best of our own Provincial varieties." Surely that is encouraging. We quite agree with the Director that of all experimental work on the farm, there is none of greater value than that touching selection of seed, and trial of varieties.

Whether wheat can be grown year after year without the aid of artificial manures is a question about which the Farm authorities are interested. All sorts of manures have been used in other plots than those set apart for this experiment. The result arrived at is that manures are essential. Poudrette is said to be the best; saltpetre and bone dust second; sheep dung and gypsum third. It has been proved over and over again that by keeping land under one kind of crop for years without rotation, some ingredients in the soil essential for plant food are exhausted. That is an elementary lesson in English farming. It is odd that a contrary belief should be so prevalent with Indian agriculturists. Another Indian agricultural fallacy is that the ashes of dung are useful.

Ploughing dry parched up indigo *khoontees* into the land is held to be green soiling at the Cawnpore Model Farm.

We are not surprised to hear that the results have been naught, although indigo crop ploughed in, with gypsum added, has resulted in the largest yield derived from any manure. It is, however, too expensive an earth condiment to be of much, if any, practical use to ryots. Fresh indigo refuse, accompanied by lime, hemp, and gypsum has done good. Road scrapings have given a larger yield than even ammonial chloride. Giving "anything" in the shape of manure is better than no manure at all, we are told.

In the matter of irrigation, well water has once more proved itself superior to canal water, although the cost of the former is double that of the latter.



## General Articles.

### TYPES OF IRON GIRDER BRIDGES, INDIAN MIDLAND RAILWAY.

WE furnish the third of the series of Plates giving details of the main girders of these Bridges. The Drawings, as said before, are self-explanatory. The annexed Plate refers to the 100 feet clear span through bridge, some particulars relative to which will be found in our issue of 25th August last.

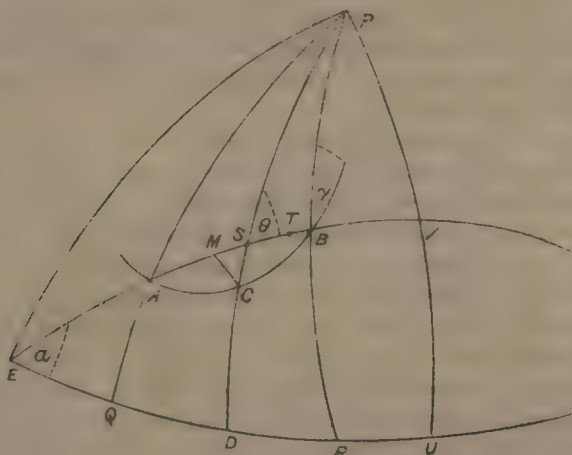
### NOTES ON NAVIGATION.

BY A. EWBANK.

#### IX.

THE present series of papers may now be concluded with the discussion of a certain theorem the accidental examination of which gave rise to the production of these Notes. The theorem in question has long reigned in nautical text books, and is a theorem relating to what is called maximum separation in latitude. It seems also to be the only general theorem on the rhumb line known to those text books and hence occupies a position of honour.

Fig. 19.



In fig. 19 we have an arc A S B of a great circle which meets the equator in E. A C B is a rhumb line. If a ship sails on A C B we may ask at what point her distance from the arc A S B is a maximum. If C be the point in question, and we draw an arc S M of a great circle normal to A S B, then C M is the maximum distance of the ship from the arc A S B.

If the latitude of A equals that of B, then obviously C is the middle point of the small circle A C B. Also, M is then the middle point of A S B. Moreover, the arc C M, if produced, will pass through P. In this particular case there is no calculation necessary.

But if the latitude of A is not equal to that of B, then we cannot assume that C bisects the rhumb line A C B, or that M bisects the great circle A S B, or that C M produced passes through P.

Now let us ask a different question. It is desired to determine the point C, not by the condition that C M is a maximum, but by the condition that C S shall be a maximum where S is the point in which the great circle arc A B is cut by the meridian through C. In this case we give up the condition that C S shall denote the shortest distance from C to the great circle A B. In other words, the angle at S will possibly be an acute angle. This angle is denoted by  $\theta$  in the figure.

If we assume the latitude of A equal to that of B, the problem again becomes unworthy of statement, for it is obvious that C is again the middle point of the arc A C B. We shall therefore consider the latitude of B to exceed that of A. It follows that  $\gamma$ , the rhumb line course, cannot be a right angle. This rhumb line also cannot be a small circle. It is a spiral curve, which, starting from A, never returns to A.

In the figure we assume that E A and E B are both acute angles. In this case if V be the vertex, we have P A V and P B V each acute. Now the course  $\gamma$  exceeds the angle P A V and is less than the angle P B V. There must, therefore, on the arc A S B, be some point T such that the angle P T V shall equal  $\gamma$ . We might propose to discover the position of this point T. It is possible that T is the point S where C S is a maximum and the arc C S lies on the meridian C P.

But clearly, we should not assume the identity of the points S and T. They would be identical were A and B in the same latitude. This useless case we have, however, formally excluded from our investigations.

The point T may be thus defined. If a ship could sail along A S B her course at T would be the same as it is throughout the rhumb line A C B. The length C S is now not to be properly described as the distance of C from A S B. C S is called the "separation in latitude" of C from the great circle A S B. Thus what we have to discover is the point not of greatest distance from A S B, but of "greatest separation in latitude." And the theorem we are about to discuss is called the theorem of the maximum separation in latitude.

Should the results of our inquiry show that the point T coincides with the point S, then in order to find when C S is a maximum we may attack the simpler problem of finding a point S such that P S V =  $\gamma$ . This method for determining the position of S, and thence the value of C S and the position of C, is given in a well-known nautical text book. The title of the book is "Practical Navigation and Nautical Astronomy." It has certainly passed through ten editions, and it may have passed through more. The author is Lieutenant Raper, R.N. The identity of the points S and T is not proved in the tenth edition of this text book. The identity seems to be taken for granted. In calculating the position of S, we shall incidentally inquire whether such identity exists.

In fig. 19, A E Q =  $\alpha$

$$\therefore P V = 90^\circ - \alpha$$

$$\sin P V = \sin P S \sin \theta$$

$$\text{or} \quad \cos \alpha = \sin P S \sin \theta$$

$$\text{Let } E Q = \lambda_1; E D = \lambda$$

$$\text{Let } Q A = l_1, D C = x$$

In the rhumb line we have—

$$(\lambda - \lambda_1) \cot \gamma = \log \frac{\tan x + \sec x}{\tan l_1 + \sec l_1}$$

This result is obtained by considering the rhumb line from A and as far as C. We are then practically drawing a rhumb line A C to correspond to a great circle arc A C.  $\gamma$  is a constant and is independent of the position of C. Did we wish to know the value of  $\gamma$ , we should use the equation

$$(\lambda_2 - \lambda_1) \cot \gamma = \log \frac{\tan l_2 + \sec l_2}{\tan l_1 + \sec l_1}$$

where  $l_2$  and  $\lambda_2$  refer to B.

$$\text{Again } E P V = 90^\circ$$

$$\therefore E P S = 90^\circ - V P S$$

$$\text{and } \cos P S V = \cos P V \sin V P S$$

$$\text{or } \cos \theta = \sin \alpha \cos E P S$$

$$= \sin \alpha \cos E D$$

$$= \sin \alpha \cos \lambda$$

$$\text{Now } S C = P C - P S$$

$$= 90^\circ - x - P S.$$

Therefore, we require

$$x + P S = \text{a minimum}$$

$$\text{when } \sin P S = \frac{\cos \alpha}{\sin \theta}$$

$$\text{We had } \cos \lambda = \frac{\cos \theta}{\sin \alpha}$$

And, therefore, from the equation

$$(\lambda - \lambda_1) \cot \gamma = \log \frac{\tan x + \sec x}{\tan l_1 + \sec l_1}$$

we may consider  $x$  a function of  $\theta$

Thus the expression  $x + P S$  is a function of  $\theta$ .



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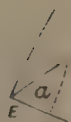


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Therefore, for a minimum, we require

$$\frac{dx}{d\theta} + \frac{d}{d\theta} P S = 0$$

Now  $P S = \sin^{-1} \left( \frac{\cos \alpha}{\sin \theta} \right)$

$$\begin{aligned} \therefore \frac{dx}{d\theta} P S &= \frac{1}{\sqrt{1 - \frac{\cos^2 \alpha}{\sin^2 \theta}}} \cdot \frac{-\cos \alpha \cos \theta}{\sin^2 \theta} \\ &= \frac{-\cos \alpha \cos \theta}{\sin \theta \sqrt{\sin^2 \theta - \cos^2 \alpha}} \\ &= \frac{-\cos \alpha \cos \theta}{\sin \theta \sqrt{\sin^2 \alpha - \cos^2 \theta}} \end{aligned}$$

We have next to find  $\frac{dx}{d\theta}$ .

The rhumb line equation may be written

$$(\lambda - \lambda_1) \cot \gamma = \log \frac{\tan \left( 45^\circ + \frac{x}{2} \right)}{\tan \left( 45^\circ + \frac{l_1}{2} \right)}$$

or  $\lambda \cot \gamma - \lambda_1 \cot \gamma = \log \tan \left( 45^\circ + \frac{x}{2} \right) - \log \tan \left( 45^\circ + \frac{l_1}{2} \right)$  where  $\lambda_1 \cot \gamma$  and  $\log \tan \left( 45^\circ + \frac{l_1}{2} \right)$  are constants.

$$\text{Also } \lambda = \cos^{-1} \left( \frac{\cos \theta}{\sin \alpha} \right)$$

Therefore, if we differentiate the rhumb line equation as it stands, we obtain the equation

$$\cot \gamma \cdot \frac{-1}{\sqrt{1 - \frac{\cos^2 \theta}{\sin^2 \alpha}}} \cdot \frac{-\sin \theta}{\sin \alpha} = \frac{1}{\cos x} \frac{dx}{d\theta}$$

$$\therefore \frac{dx}{d\theta} = \frac{\cot \gamma \cos x \sin \theta}{\sqrt{\sin^2 \alpha - \cos^2 \theta}}$$

Therefore, the equation

$$\frac{dx}{d\theta} + \frac{d}{d\theta} P S = 0$$

gives us

$$\cot \gamma \cos x \sin \theta = \frac{\cos \alpha \cos \theta}{\sin \theta}$$

$$\text{and } \cos \alpha = \sin P S \sin \theta$$

$$\therefore \cos x = \frac{\tan \gamma \cos \theta}{\sin^2 \theta} \cos \alpha$$

$$= \frac{\tan \gamma \cos \theta}{\sin^2 \theta} \sin P S \sin \theta$$

$$\text{and } \cos x = \sin P C$$

$$\therefore \frac{\sin P C}{\sin P S} = \frac{\tan \gamma}{\tan \theta}$$

$$\text{Now } P C > P S$$

and each is an acute angle

$$\therefore \sin P C > \sin P S$$

$$\therefore \tan \gamma > \tan \theta$$

Also  $\gamma$  and  $\theta$  are acute angles

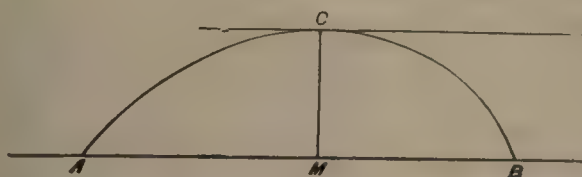
$$\therefore \gamma > \theta$$

Thus  $S$  is not the point where the angle  $P S V = \gamma$ . Hence the theorem assumed in nautical text books which identifies  $S$  with  $T$  is now disproved.

The figure then shews that  $T$  must lie between  $S$  and  $B$ . The method given in nautical text books for finding  $C$  is to run a meridian through  $T$ . We see that the point so determined lies between  $B$  and the real point  $C$ .

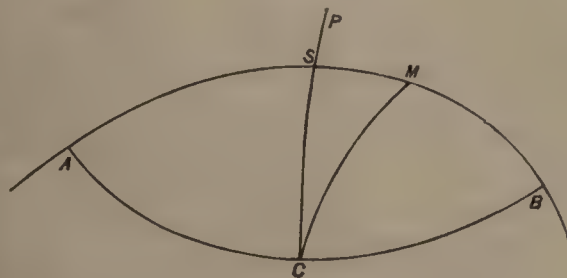
It seems probable that the author of the theorem now disproved obtained his result not by inaccurate analysis, but by loose general reasoning.

Fig. 20.



In fig. 20 A C B is any plane curve and A B is a straight line. If we desire to find that point C whose distance from A B is a maximum, we may inquire for that point where the tangent shall be parallel to A B.

Fig. 21.



In fig. 21 A S B is an arc of a great circle and A C B is a rhumb line, or any other curve different from the great circle.

If we inquire at what point C we shall have the maximum distance from A S B, we might loosely say that the tangent at C should be as nearly as possible parallel to A S B.

Our language is loose because the tangent at C has a definite direction for any point C arbitrarily chosen. But as A S B is a curved line, we cannot strictly say that any straight line should be parallel to it.

Now let us join P C cutting the great circle in S. If we measure the distance from C to the great circle along the line C P, we are measuring the distance in an arbitrary manner.

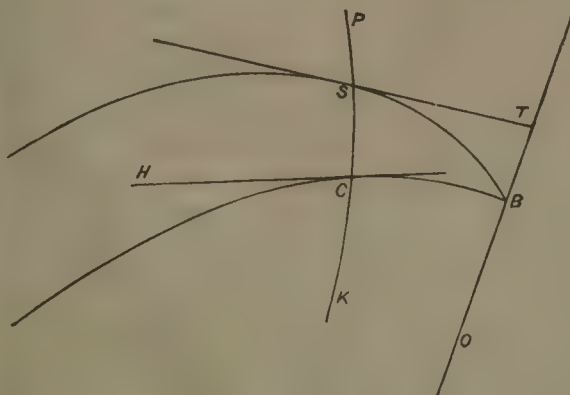
Finally, if the angle P S B was in any case equal to the angle P C B, we still learn nothing about the directions of the curves at S and C. All we learn is that the interior angles C S B and S C B of the curvilinear triangle S C B together are equal to two right angles. In a plain triangle this would imply that S B is parallel to C B, or that the point B is at infinity.

But in a spherical triangle, or in other curvilinear triangles, we can have C S B and S C B together equal to two right angles without B starting for infinity.

Thus it seems that the reasoning for fig. 20 was hastily generalised and applied to a sphere where it has led to an incorrect result.

It might perhaps be thought that if S B and C B are two curves on the sphere which are cut at the same angle by a great circle P C, then the tangent at S to the curve S B will equal the tangent at C to the curve C B.

Fig. 22.





To examine this point let  $S B$  and  $C B$  (*fig. 22*) be two great circles, and let them be cut at equal angles by the curve  $P S C$ , also let  $C B$  and  $S B$  be each less than a quadrant. Let  $O$  be the centre of the sphere. Draw  $S T$ , the tangent, at  $S$ . This line will meet  $O B$  produced. The lines  $O T$  and  $S T$  determine a plane  $O B S T$ . The point  $C$  is by hypothesis not in this plane. If  $H C$ , the tangent at  $C$ , to the circle  $C B$  is parallel to  $S T$ , it will be parallel to the plane  $O B S T$ . Therefore, it will not meet the plane. Therefore, it will not meet  $O B$  which lies in the plane. But  $H C$  produced does meet  $O B$  produced. Therefore,  $H C$  cannot be parallel to  $S T$ . In this reasoning we have not inquired whether the angle  $C S B$  is equal or unequal to  $K C B$ , so that the equality of these angles will not help to rebut the reasoning.

If, however, the arcs  $S B$  and  $C B$  are both quadrants, we shall have  $S T$  and  $H C$  each parallel to  $O B$ , and hence they will be parallel to each other. In this case the angles  $K C B$  and  $C S B$  are also right angles. In that particular case of the theorem of maximum separation where the rhumb line was a small circle, we had right angles  $P S T$  and  $P C B$  in *fig. 19*. Hence we again see that to a hurried generalisation from a particular case was probably due the enunciation of the "theorem of maximum separation."

This last paper is so written that it can be read without the reader having seen the former papers. The present paper is likely to be of interest to all nautical men who study the theory of navigation.

As this number of *INDIAN ENGINEERING* may fall into the hands of some reader who has not the former numbers by him, it is desirable that he should be able to examine the present paper and see if it really does contain that disproof which it professes to contain.

#### BANGALORE WATER-SUPPLY.

ESSAY CONTRIBUTED BY S. TOMLINSON, ASSOC. M.  
INST. C. E., F. R. MET. SOC.

Deputy Executive Engineer, Municipal Water-Works,  
Bombay.

1. AFTER the numerous reports and projects of the past 20 years, it is scarcely to be expected that there are still "pastures new" likely to yield an economical supply of water for the troops at Bangalore, but the author believes that the proposals which follow will be deemed "original," as contemplated in the advertisement inviting Essays, and that the scheme will also be found to be both economical and workable, and to provide the troops with pure drinking water.

2. The present supply from the Halsur Tank is not satisfactory as to quality, and would be positively dangerous in time of an epidemic in the Cantonment Bazar. Neither is it very economical, and, if supplanted, the present working expenditure on these works will become available for payment of interest on capital, or for the working expenses of securing the new supply.

3. The heavy daily expense of pumping is a serious drawback to any scheme which necessitates its use. Nor is the question of daily expenditure the only objection. The maintenance of engines and pumps and the contingencies attached to their use and the skilled labor required for repairs, all form objections which deserve careful consideration before deciding upon a scheme for supply by pumping at a place situated as Bangalore is.

4. The author, therefore, considers that, if practicable, a gravitation supply is much to be preferred in the case under discussion. He further considers that if, say, for example, Rs. 10,000 per annum appear to be necessary now as an annual outgo, it will be, *ceteris paribus*, more prudent that it should be paid as interest on capital to which no contingencies attach, than as working expenses for fuel, labor, wear and tear of engines and plant, which may increase greatly from year to year in the future.

5. After a careful perusal of the compilation "Bangalore Water-Supply," and after visiting Bangalore and the locality, the author proposes to supply the troops with

water from the reservoir known as Sankey's or Ooperhalli Reservoir. It is generally agreed that this project can never realize the results expected from it, and it has been regarded as a total failure. The reservoir itself leaks heavily, this appears to be conclusively proved by the rate of fall per day of the water surface in the dry season. The works have remained for some years practically undeveloped, and are unremunerative to the Mysore Government, to whom they belong. It appears, therefore, that there would be no difficulty in arranging with the Mysore Government for a supply of water required for the troops, either by payment to the Mysore Government per 1,000 gallons of water used; or by acquiring the works at a valuation based, not upon their actual cost, but upon their known capacity to yield water.

6. The scheme proposed is based upon the following data of requirements:—

(a.) The quantity of water required is, on the average, under 60,000 gallons per day, the maximum quantity being 78,000 gallons per day (24 hours). The delivery main should therefore be capable of delivering 78,000 gallons in 24 hours into the cisterns of the Barracks.

An examination of the records of the actual quantities pumped, and of the actual requirements per head, shew that these quantities are sufficient (*vide* pages 91 and 163 of compilation.)

(b.) The highest level at which the water has to be delivered appears to be the cistern of the European Infantry Barracks. This appears to be 2,999.62 on datum, say, 3,000. Only about one-half of the water is required at this level, the remaining portion is to be supplied at a level of say, 2,970. A main, therefore, which will discharge 78,000 gallons at a level of 3,000 has a surplus capacity.

7. The top water level of Ooperhalli Reservoir appears to be	3,033	on datum
The high level sluice	3,019.50	"
The low level (new) sluice	3,004.50	"

8. The quality of the water has not been questioned in any of the reports given in the compilation, but at the same time no analysis of its water is given. The author does not believe an analysis will prove unfavourable. But he does believe that the water should be filtered to improve its appearance. There seems no possibility of any dangerous pollution of the reservoir or the watershed, and any impurities the water contains are not of a dangerous character.

In the following calculations provision is made for filtering and for the loss of head caused by filtering.

The author would here remark that the discoloration of the water from the earthy matter eroded from the bed will probably become much less in a few years; but, on the other hand, there will probably be a growth of vegetable matter. This, however, will not be dangerous, and will be easily removed by filtration, as provided.

9. Seeing that the reservoir leaks so much, it is evidently politic to remove the water from it as quickly as possible, even if the surface were usually at a level sufficiently high for the purposes of the demand upon it. The author, therefore, proposes to construct a service reservoir of masonry, to hold the water required for the troops only.

10. The capacity of this reservoir must be 60,000 gallons multiplied by the number of days it is estimated that no water will flow into it. This is always a difficult factor to determine; and in this case it practically depends upon the use made of the remaining portion of the supply to the reservoir and of the time required to draw it off. The assumption of the number of days becomes therefore empirical; the author believes that, with a rainfall *régime*, such as Bangalore has, 365 days will be sufficient. The required capacity is therefore 21,900,000 gallons, or say 3,500,000 c. feet. This requires a basin 600 feet square and 10 feet depth of water, or its equivalent.

11. The level of the Service Reservoir must evidently be so placed that when almost empty there must be



sufficient head for filtering and delivering where required.

12. A 6" cast-iron main is proposed to be laid from the service reservoir to the E. I. Barracks, there joining the present system of distribution mains. The service reservoir is proposed to be built near the reservoir between the south-east inlet channel and the outlet or delivery channel. The author has not measured on the ground the length of piping required; but it appears the line shewn on the plan attached hereto will not exceed 20,000 feet in length. A 6" main 20,000 feet in length will discharge 78,000 gallons in 24 hours when under a head of 9 feet. Allowing 1' 6" for loss of head in filtering, it appears that the level of the bottom of the service reservoir may be placed at 3010.5 on datum. The top water level of the service reservoir, when full, would thus be 3020.5.

13. The top water line (3020.5) of the service reservoir is thus practically the same as the old sluice level (3019.97) of Ooperhalli Reservoir. It would be, therefore, 14 feet below high water mark of the large reservoir and 15 feet above the new low level sluice.

(To be continued.)

NOTES FROM HOME.

(From our own Correspondent.)

THE Iron and Steel Institute has been holding its annual meeting at Edinburgh during the present week and it has been largely attended. An interesting paper was read by Mr. Hadfield on "Manganese Steel." Amongst some of the uses to which it was suited from its extreme hardness was the applicability for car and other wheels to compete with those made of chilled iron. These wheels have been tested in America and have given very satisfactory results. Wheels could be tested with more than 100 blows by a heavy sledge hammer without a fracture occurring. One set in America had already run 200 thousand miles under heavy engines of the "consolidation" type and were still only partly worn, whilst the life of ordinary chilled iron wheels did not average more than from 50 thousand to 60 thousand miles.

It is stated that on the 31st instant the special Edinburgh expresses which were put on at the beginning of the month by the London and North Western and the Great Northern Railway companies will be discontinued but that the other express services will go on. As a result of interviews between the managers of the companies other changes may shortly be announced, but nothing has as yet been definitely settled. It is satisfactory to note that the Midland Company has not taken part in the race. It cannot be contended that this company has not at heart the interest of the public seeing that many years since it was the first to set the example of giving third class accommodation on all its trains a policy since slowly adopted by other companies.

A remarkable instance of the improvement of Railway credit is afforded by the fact that the new issue of £1,200,000 of Four per cent Preference Stock of the Great Eastern Railway Company issued at par carrying a dividend of 2½ per cent only until 1891 is now quoted at 7 premium. Twenty years ago a Six per cent Great Eastern Preference Stock was quoted at 75, a Four per cent today stands at 107. From the Railway Reports of the past year it appears that on 21 lines there was an increase of the gross receipts of about £604,000 earned at an extra cost of £324,000 leaving a gain of £208,000 in the net receipts for the half year. Of this sum the ordinary shareholders received over £200,000 as increased dividends.

In the last half yearly report of the City of London and Southwark Subway Company, it appears that the best method of working the line and the nature of the power to be used has for some time past occupied the special attention of the directors. In many respects the system of an endless cable would seem to be the best, but it has certain disadvantages in its application to the working of this line, which are not easy to overcome, and the directors have come to the conclusion that electrical force conveyed by continuous conductors offers the best solution to the difficulty and will give a motive power at once trustworthy and economical.

It is announced that the next (the 6th) examination of candidates for the offices of Municipal Engineer and Local

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CHITTAGONG;  
The 10th September 1888.

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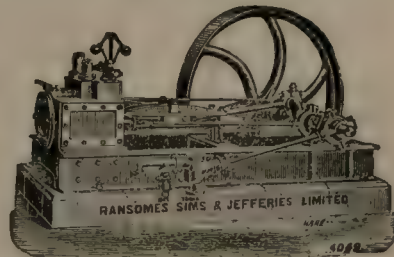
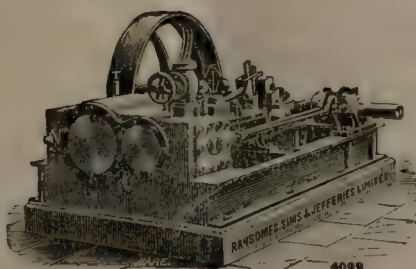
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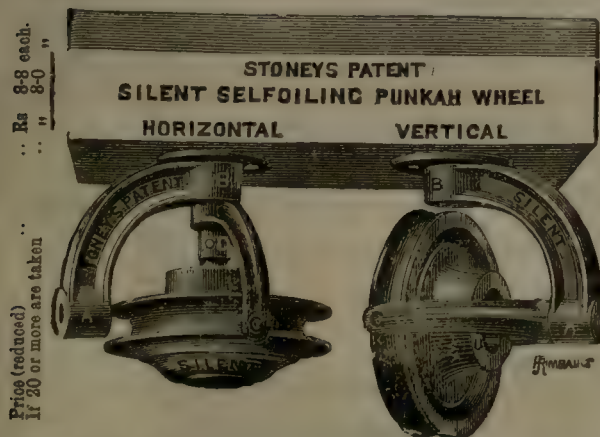
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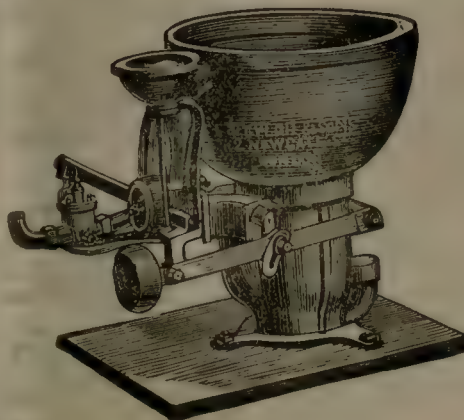
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As the issues of the journal containing the articles headed as above are out of print, and sufficient inducement having offered, the matter has been reproduced in pamphlet form to meet the requirements of District Officers and others in Bengal and elsewhere.

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## Obituary.

BELL.—September 10, at Fopstone Road, Kensington, London, Lieutenant-General Harry Wainwright Bax Bell, Royal (late Bombay) Engineers, aged 67.—(By telegram.)

# INDIAN ENGINEERING.

SATURDAY, SEPTEMBER 29, 1888.

### CIVIL ENGINEERS IN THE P. W. D.

ACCORDING to the "distinguished Indian official" alluded to in the leading article of our issue of 7th July as having been quoted in an article on "Civil Engineers in India" in London *Engineering*, there is yet balm in Gilead for the long expectant Civil Engineer, inasmuch as an honor or emolument conferred upon a member of the P. W. D. should he happen to be an R. E. may be taken as an earnest of what the Civil Engineers may expect some day.

It is true that day is a long one, some 20 years having elapsed since the Civil Engineers first obtained a distinct admission of the justice of their claims from the Secretary of State, during which time a few concessions have been made; but our article of 15th September gives a table shewing how very far from equal the position of the two branches of the P. W. D. still is, even in the case of the most favored of the C. E's.

However, if the argument of the above-mentioned official be true, some hope is still to be drawn from the facility with which Government redress any disabilities the Royal Engineers labor under as compared with the Civilians or with other branches of the army. The pensions of the R. E's. under the old scale not being considered adequate, they have lately been granted the Staff Corps pensions, but though both the Government of India and the Secretary of State have frequently expressed their sense of the desirability of the equalisation, as far as possible, of the furlough allowances and pensions of Civil Engineers with those of Military Officers, it does not seem to have occurred to either of them, that this was a favorable opportunity to declare a scale of pensions for all alike, and thus abolish one at least of the invidious distinctions.

They might even extend any concession to all Civilians alike in the P. W. D. who take their pensions out of India, for most of the men from Indian Colleges are domiciled in the country, and therefore so far as they are concerned the favor would not be a costly one.

Again, it was discovered that R. E's. entering the Department were at a disadvantage in point of age compared with Cooper's Hill men. No sooner is this pointed out than it is remedied, and very properly too; but had the reverse been the case, it is at least doubtful, to judge from past experience, if a remedy would have been so promptly applied.

Would it be too much to suggest to the R. E. heads of the P. W. D. that, so far as that Department is concerned, their plain duty is to treat all alike, and endeavour to obtain a concession admitted to be just, for the Civilians under them, quite as much as for their comrades.

We say their duty, for the Government they serve, and which in fact they represent in that branch, have repeatedly expressed in the most unequivocal terms their desire to equalise both parties.



It would be assuming too much to say that they never have recommended an improvement in the position of the Civil Engineers, but if they have, their efforts have not been crowned with the success attained when they were directed to the advantage of their own Corps, in whose grievances they would naturally take a warmer interest.

Absolute equality is not possible, for there are some few advantages which must always remain with the R. E. alone, such as the possibility of service in other departments should the P. W. D. prove distasteful or the aspirant possess influence; the ability to exchange for English service, and the certainty of tenure in case of reductions.

This last point has perhaps been made too much of in relation to the reductions of 1879, and those now impending, for though an undoubted hardship to the C. E's. it is unavoidable, because if it is necessary to keep up a certain number of Royal Engineers in India, it is incumbent on Government, in the interests of the public service, to employ them in the P. W. D. rather than pay them for doing nothing.

It may, however, be pertinently asked in this connection, how much useful military knowledge remains in an R. E. after a service of 25 years in Civil Engineering, or worse still, the accounts branch employment, in which it seems tolerably congenial to him.

Equalising the pensions of the Civilians either by granting them the same pensions as the Royal Engineers, or their own scale in sterling, is a matter that affects even the R. E's. themselves.

For there are many men who would retire now after 20 years' service, could they obtain a sterling pension, but with the present prospect of a rupee at half value, nobody can afford to leave the Department until obliged, and this is one main cause of a block in promotion that affects Civil and Royal Engineers alike.

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#### INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE.

WE are glad to learn from a Report of the eleventh annual meeting of the Association that it continues to flourish. During the last twelve years it has risen from small beginnings to the position which it occupies at this day. The success that has continued almost uninterruptedly to attend the venture is due entirely to the unflagging energy and indomitable courage of one man—Dr. Mohendro Lall Sircar, C.I.E., its Honorary Secretary. At a great sacrifice of time and labor, under the most desponding circumstances, he has been able to establish an institution of which any country may well be proud. For a mere trifling fee, any one so disposed, might attend lectures on science in almost all departments, delivered by some of the best scientists in Calcutta. That it has become very popular with the student class goes without saying. Even to Hindu ladies, who are pretty far advanced in their studies, these lectures have proved a source of attraction; and a special practical class in

chemistry has been opened for their sole benefit. Altogether 129 lectures on a variety of subjects were delivered during 1887-88 by Father Lafont, Dr. Mohendro Lall Sircar, Baboos Ashutosh Mookerjee, Pramnatha Nath Bose, Jagadish Chunder Bose, Ram Chunder Dutta, and Dr. R. Sen. The receipts of the Association during the year were Rs. 4,323, and disbursements Rs. 3,196.

From the Report of the Honorary Secretary read at the meeting referred to above, it appears one of his colleagues, Mr. A. M. Bose, had proposed, in the previous year, that a practical scheme of technical education might be inaugurated. The Secretary remarked that apart from the question of funds there were other difficulties in the way. The subject embraces a wide field, including all industries, trades and professions, which require special knowledge, and could not engage the attention of a science association. The next point to be considered is what branches of such education, what especial industry or handicraft, could be taken up by the Association. The speaker pointed to a good deal of misconception which exists in regard to the whole subject of technical education, and there is a good deal of sound sense in what he said, of which laymen who talk so glibly about it could hardly understand. It is not a thing of hot-house growth and cannot be forced upon any people. It will develop with the growth of scientific knowledge among them, and unless a market is to be found for the disposal of its products, it is idle to suppose that they can be manufactured for any good purpose. There must be a demand before the subject of supply could be discussed. Where is the earthly necessity of imparting special knowledge to a man when that knowledge will be of very little use to him in the struggle for existence. But few persons who are crying themselves hoarse on this subject care to discuss the obstacles in its way.

During the past 12 years a sum of Rs. 1,40,000 have been realised as donations, of which sum nearly a lakh has been expended in order to give the Association a local habitation and a name. Since then contributions have been coming in very slowly, and it is therefore not to be wondered at that the Honorary Secretary expressed his dissatisfaction at the progress it has not been enabled to make, and also at the want of sympathy and support it had received from his countrymen, who do not seem to appreciate the importance of this most potent regenerating institution. He reminded them that a knowledge of the physical sciences is the foundation of all material and moral progress, and that the civilisation and power of a nation are in direct proportion to its stock of scientific knowledge. If these observations were true of other countries, how forcibly they apply to the present condition of India, where knowledge, properly so called, is at its lowest ebb, and it was the more imperative that the natives of the country should cultivate those sciences. The acquisition of this knowledge would help in more ways than one the regeneration of his countrymen; they would contribute



to its advancement by original research and to its varied applications to the arts and comforts of life. In order to attain this end there were two essential requisites—(1) to bring together the most improved scientific instruments and apparatus which illustrate and demonstrate the principles of the various branches of science, and (2) to secure the services of men who could devote themselves entirely to keeping pace with the progress of science generally, and to carry on the research in some particular branch as a speciality. The speaker very humorously alluded to the “sinews of war” in this connection, and we reproduce his apposite remarks on the subject. He says:—“What is the requisite that will secure the requisites? That one thing needful in this hard world of ours, I do not know what it may be in other worlds, but the world in which our lot is cast, that one thing needful is money, the most wonderful of human inventions, because the parent of all inventions, and the most potent transformer of energy.” The Laboratory, we are sorry to learn, is about coming down, and if it is not replaced by a new one, the practical work of the Association must, of necessity, come to a standstill. His Honor the Lieutenant-Governor followed the worthy Doctor, and exhorted the natives of India not to turn a deaf ear to his representations. He fully coincided with his views, that the Association had, and was doing good work, and the only drawback in the prosecution of the useful was want of funds without which no actual progress could be made. He endorsed every word that fell from the lips of the last speaker, and he would add his own voice in recommending scientific training to the youth of Bengal. He dwelt on its practical utility as the indispensable landmark of all manufactures, of many arts and many professions, and looking to its importance he trusted that the Doctor's appeal will not be in vain, concluding with a wish that the Association may flourish through long ages and hand down to posterity the name of its principal founder and Secretary.

#### PROGRESS IN THE NORTH-WEST.

TURNING to the heading “Public Works” in the North-West Provinces and Oudh Administration Report for the year ending 31st March 1887, we find that Engineers spent Rs. 55,48,800 on public works of sorts. A striking instance of professional moderation, for they were officially entitled to spend Rs. 56,48,000. And yet there are always scoffers, cheap Jack Catos and Ciceros, men of restless uneasy virtue, always prepared to swear that the Department never can by any chance keep within its estimates. Let them add up the totals in the North-West Provinces and Oudh Administration Report for 1886-87, and be confounded.

Eighty-three miles of Railway on the Lucknow, Sitapur and Seramow line were completed and opened for traffic during the year under review. Also the Indian Midland Railway bridge over the Jumna at Kalpi, and the section of the line from that place to Jhansi. The working of the Cawnpore-Achneyra Railway was transferred to the

Bombay, Baroda and Central India Railway Company. The interest of the canal work undertaken during the year centred in the Nadrai Aqueduct, in connection with the Lower Ganges Canal, which, it will be remembered, succumbed to unusually heavy floods in October 1884, and provoked a deal of professional discussion as to the amount of water-way it was provided with, and as to the amount with which it ought to have been provided. It was a tempting subject for men who are fond of being wise after the event. It concerns us mainly to know that Rs. 13,00,000 of the Public Works Canal grant were, in the course of 1886-87, expended on the rehabilitation of this demon-possessed aqueduct.

The balance of expenditure, about Rs. 6,00,000, was devoted to completion and extension of the distributing and drainage channels of the different systems. Economy is the irrigation order of the day; and so we find a decrease of Rs. 75,000 shewn under the heading “Establishment Charges,” possibly an economy; possibly the very reverse. We always incline to look with a certain amount of suspicion on savings effected by means of reductions in the supervising establishment. Scamped work is a more expensive item to budget for than directing intelligence and conscientiousness. Here is official record of a palaver, and its coming to nothing:—

Rules which should authorize the Canal Department (1) to refuse canal irrigation to lands assessed as irrigated from other sources, and to which canal water has never yet been supplied, and (2) to withdraw canal water from lands of this description to which it was admitted since settlement, and which are now receiving it, were recommended, after a prolonged discussion, to the favorable consideration of the Government of India. The soundness of the principle, that the supply of water in the rivers of Upper India which can be utilized for irrigation should, being limited, be restricted to lands which can procure water from no other source, was admitted; but practical difficulties in application of the proposed rules were pointed out, and eventually, as the present rules were reported to have proved sufficient in the special case on account of which the amendments had been advocated, the subject was allowed to drop.

The Survey Department worked at cadastral maps on the scale of 16 inches to the mile—a very good scale too. The Agricultural Department established schools for the education of its right hand men, the Putwarries, and tried its hand at extermination of *usar* and preachment to district agriculturists of the advantages accruing from the use of Western World devised ploughs. We are not told what results were born of any of these missions. None at all, we suspect. *Usar*, and agriculturists, and Putwarries are all a deal too conservative, and too wide-awake to be brought into Departmental bondage, and fettered with red tape. A Botanical survey of Northern India was undertaken during the year under review.

Its forests yielded the Government of the North-West Provinces and Oudh a profit of six and a half lakhs of rupees. As to which governmentally unearned increment



we are told that "the surplus was in some measure accidental, because the stocks accumulated in the forest depôts from the works of the previous year were unusually large, and sales were much in excess of the new supplies. The extensive operations in the Oudh Circle to provide sleepers for the new Railways have with the completion of those lines, come to an end for the present, and with them has ceased a demand which was very profitable to the revenue of the forests, and at the same time advantageous to the growth of the younger stock, by the removal of timber which was fitted for few other purposes. This is ungracious. The fact remains that there was a surplus, that the Forest Department earned it, and that officers belonging to the Department are being done out of 8d. in every two shillings promised them as pension allowance, as half pay when on leave. Timber to the amount of five million cubic feet, fuel to the amount of six and a half million cubic feet, and minor produce to the value of four lakhs of rupees were removed from the forests during the year.

These figures include the produce given to villagers on the borders of the forests, who may be entitled to free supplies for their requirements.

A large number of convicts continue to be employed in the construction and alteration of jail buildings, with great advantage both in economy and in the rapidity with which the works are carried out. They helped towards construction of the new jail at Benares which was completed in August. Results have, we are told, amply justified the expectations with which this form of prison employment was initiated.

The information vouchsafed under the heading "Mines and Quarries" is exceedingly meagre. Here is the whole paragraph:—

The following figures shew the demand, collections, and balance on account of mines and quarries for the revenue year 1885-86:—

	Demand, including arrear.	Collections.	Recoverable arrears.
	Rs.	Rs.	Rs.
Water-mills	... 12,669	12,541	128
Iron and copper mines	... 573	564	9
Stone quarries	... 63,226	63,226	...
Total	... 76,468	76,331	137

The receipts from water-mills and iron and copper mines are collected in Kumaun and Garhwal; those from stone quarries in Mirzapur.

The total trade with Tibet and Nepal amounted to 46,10,438 maunds, against 42,36,795 maunds in the preceding years.

There is a slight decrease in the traffic with Tibet, owing to a falling off in the import of salt, and the export of grain. There is an increase in the imports from Nepal—of timber and firewood mainly.

The total rail-borne traffic of the Provinces amounted to 473 lakhs of maunds, of which exports consisted of 248 lakhs, and imports of 225 lakhs, against 260 and 203 lakhs maunds, respectively, in the preceding year.

## Notes and Comments.

**THE PETROLEUM WELLS.**—The petroleum oil wells in Khelat and the Murree Hills are to be made over to the Frontier Railway authorities to manage.

**THE RANAGHAT-GYA RAILWAY.**—A survey is sanctioned of the Railway from Ranaghat to Gya, and has been placed under the control of the Bengal Government. Mr. J. Ramsay has been appointed to the charge of the survey.

**THE GOVERNOR OF LADAK.**—Mr. Atkinson, formerly of the Indian Public Works Department, who for several years has been in the service of the Cashmere State, constructing the road to Murree, has been appointed Governor of Ladak.

**A SUCCESSFUL MADRASSEE.**—Mr. J. H. Ellis, son of Mr. John Ellis, Honorary Assistant Engineer of the Madras P. W. Department, an old Dovetonian, who had proceeded to England to prosecute his studies, returned to Madras, after he had passed successfully out of Cooper's Hill.

**AN ACKNOWLEDGMENT.**—We have been favored by the Government of India, with the Report, Index Plan, and Tabular Statement shewing progress to 30th June 1888, of the Kidderpore Dock Works, the substance of which information has already appeared in this Journal.

**CONTRADICTION.**—"Mr. Duff-Bruce is finding some difficulty in raising the capital to work the Kalka-Delhi Railway project."—"No difficulty has been experienced in raising the capital for the Kalka-Delhi Railway, for the simple reason that no attempt has yet been made to raise the capital. Indeed the Company has not yet been formed."

**AN ACKNOWLEDGMENT.**—We have received a memorandum from the Director-General of Railways "on arrangements to be introduced for saving time and labor in the preparation of designs and estimates, and for rendering information on technical subjects more readily accessible to Engineers." We may have something to say on this subject in a future issue.

**LOCAL IRON MANUFACTURE IN MYSORE.**—In the year 1886-87, 89 iron manufacturing forges were at work in the Shemoga District. In 1887-88 they have dwindled down to 19, yielding about 12,000 rupees. It is reported that the restrictions introduced by the Forest Department as regards the cutting of firewood trees for charcoal have interfered with this manufacture.

**LAND IMPROVEMENT LOANS ACT.**—The Madras Government notice with great satisfaction the successful efforts of Mr. Sturrock in getting the ryots of the Palladam taluk to take loans under the Land Improvement Loans Act so largely, and desires to have a special report as to the number of wells dug and the area brought under well cultivation by the aid of these loans.

**THE BRIDGES ON THE S. M. R. MYSORE SECTION LINE.**—Four bridges on this line were carried away by the floods last year,—one, a twelve-feet beam bridge at Chennapatam, two twenty-four-feet beam openings at Mudder, six thirty-feet arches at Hebbala, near Mandya, and one twelve-feet arch near Seringapatam. These bridges have all been rebuilt, with the exception of the one at Hebbala, and this is fast approaching completion.

**SOME ANOMALIES.**—In Madras we find a Superintending Engineer, 2nd Class (*s. t. p.*), officiating as Chief



Engineer, 2nd Class, and in Bombay, Executive Engineers, 1st Grade, officiating as Chief Engineer, 1st and 2nd Class, while in Bengal we find a Superintending Engineer, 1st Class, officiating as Chief Engineer, 3rd Class. These are differences with a very wide distinction, and the hardship entailed in the last case is glaring and palpable.

**BLASTING APPLIANCES FOR PERIYAR.**—Mr. Harris, the Agent for Nobel's Explosives Company, visited the works during the month of July, and gave most useful advice and instruction. A galvanometer has been indented for on the advice of Mr. Harris, who has pointed out the advantage of testing all fuses before inserting them in the charges. The purchasing of one American magneto machine, with one test box, for Rs. 511 has been accordingly sanctioned by Government.

**AN ITEM FROM KHANDEISH.**—If the project of a Railway from Chalisgaon to Dhulia were taken in hand it would serve two purposes. It would be a very extensive relief-work for the present, and a sure protection against future famines. The line was planned and sketched several years ago. If so no time should be lost in preparing for its construction. The only costly part of the work is the erection of a bridge over the Girna; but it is believed it will be, after all, a paying concern.

**PROGRESS IN INDIAN MANUFACTURES.**—A contemporary suggests that if any wealthy and high-caste Hindu gentleman wishes to do his countrymen a real and lasting service, let him endow three or four travelling scholarships in mechanical Engineering and induce a few high-class lads to thoroughly study the subject both in India and in Europe. Once trained they would readily find employment and could do much to raise the mass of Indian workmen to a higher working level.

**MR. B. K. FINNIMORE.**—We learn that Mr. Finnimore has been relieved of the charge of the 2nd Calcutta Division and has proceeded to Darjeeling to note upon the water-supply of that town previous to his departure to Khatmandu, where he will gather the necessary information and details for the preparation of a scheme of water-supply for the Nepaulese capital. This young officer has already won excellent opinions both as regards his energy and abilities, and we wish him every success in his special mission.

**THE CARBONIFEROUS GLACIAL PERIOD.**—In his commentary on the Salt Range, and *apropos* of his contention that in its formations are not seldom found, which were formed under the co-operation of ice, Dr. Waagen enters a pathetic protest. Since the controversial Doctor is thin-skinned about criticism we will respect his tender susceptibilities, and afflict him with none of ours. The more readily since Mr. Oldham has already replied at length to the theorizings on the acceptance might easily have been prevented, and a good deal of the excavation done last year has been filled up; the actual loss of work is not serious, but the delay is annoying. At the Periyar the only work done (except the small progress with the buildings) has been the removal of the earth on the escape and on the site of the dam; a fair amount of progress has been made with the former, the rock being now exposed in many places. An attempt is being made at reducing the rate of pay for labor, and also at the introduction of piece work; the latter has not as yet been very successful, except with regard to boring holes for blasting. The rate of daily pay has been reduced from six annas to five.

**NEW POLICE COURTS, CALCUTTA.**—We learn that plans are under preparation for this new structure on the site of the present Courts, which will be dismantled. It is to be hoped the opportunity will not be lost of improving the corner of Chitpore Road, and that the new Courts will form a distinct and important feature of the town. The construction of proper Police Thannahs about the town is a subject to which we have previously referred, and when the new Municipal scheme comes into force, and the management of the Calcutta Police Force devolves upon the Bengal Police Department, it is to be hoped every pains will be taken to accomplish this.

**VOLUNTEER HEAD-QUARTERS AT CALCUTTA.**—This much vexed question—the provision of a house for the local Volunteers—still hangs fire. The only hope in the matter is built upon the chances of obtaining further pecuniary help from the Government of India. Really these schemes for buildings which are required for unquestionably public purposes should be started and carried through in a more thorough and consistent manner. Messrs. A. and J. Main, who have contracted for the ironwork of the building, are naturally awaiting orders to ship the ironwork, and their forbearance in the matter speaks very highly of their good and considerate spirit.

**BABOO BIPRO DAS PAL** :—Here is an extract from the Presidency Division Administration Report which will interest our readers, all of whom will, we are sure, be ready with us to congratulate the enterprising gentleman referred to. Baboo Bipro Das Pal, a Belcher or Assistant Engineer, has been employed connected with the tunnel works of the Khwaja-Amran extension, on the Sind-Pishin Railway.

AN inquiry has been ordered into the circumstances under which the steamer *Eden Hall* ran into the harbour wall at Bombay, displacing masonry, and doing other serious damage.

THE Singareni coal continues to improve with the depth, and quantities of really good coal from deep workings have lately been sent for use on the Madras and the G. I. P. Lines.

MAJOR GARWOOD, Superintendent, Military Works, Quetta, will take charge of the Military Works, Rawal Pindi, during the absence of Colonel Beresford Lovett, appointed to command the Royal Engineers and the Hazara Field Force.

THE earnings of the North-Western Railway during the first four and-a-half months of the current official year (1st April to 18th August) have exceeded by more than 15 lakhs of rupees those of the same period for the previous twelve months.

too and Orissa. From the other side of the mountain that Famine Relief Works have been started at Poona. They do not appear to have been initiated as yet on this side of India, although a grant of Rs. 15,000 has been sanctioned for gratuitous relief in Orissa, and furthermore, the Commissioner of the Division has been empowered to disburse Rs. 25,000 to local zemindars, under the Agriculturists' Loans Act.

**CHANGES AMONG MINING MANAGERS IN INDIA.**—We learn that Mr. C. Z. Bunning will soon leave Warora, in disgust, we presume, at some of the consequences arising from his supersession. Mr. I. J. Whitty leaves the Bengal Coal Company and will be succeeded by Mr. S. B. Wells, so well known in connection with the Kuldiah (Giridih) Colliery of the same Company. The Equitable Coal Company will have another change of Managership in February next. The Singareni Coal Concern will miss the guiding control of Mr. Theodore Hughes, who has reverted to the Indian Geological Survey. Mr. Charles Earpe of the "Alipore" and "Burrakur" Coal Companies, in Bengal, shortly goes home on leave—a well-earned respite, which none will dispute.



**MADRAS HARBOUR.**—The Madras Port Trust have Resolved,—(a) that the Engineer be authorized to proceed with the protection by wave-breaker blocks of the south arm of the Harbour, according to the sanctioned design, subject to the modification necessitated by the advance of sand outside the arm; (b) that the Engineer be authorized to proceed with such alterations to the wave-breaker crane as he considers necessary to enable it to travel round the curves of the north and south arms which it was originally intended to traverse; (c) that the Madras Government be requested to communicate with the Secretary of State in reference to (1) a design for Pier heads; (2) protection of the rubble base by concrete in bags; (3) the faulty construction of the wave-breaker crane.

**SIGNAL LIGHT FOR SHIPS.**—Referring to the recent lamentable collision in the Atlantic, Sir Bradford Leslie, M. Inst. C.E., proposes a system of signal lights for ships, which recommends itself to Engineers at least. He proposes to use two good white lights, one raised a few feet above the bows and another at a masthead. From these the "course and manœuvres of all vessels under way would be as obvious by night as they are by day, and there can be no more effective means of attaining this object than by the parallax of two white lights forming a given angle with the horizon." That is to say, two white lights which would be in a vertical line so long as viewed direct in stem to stern line of the ship; but which would be in two different vertical lines seen from any other position.

the construction and alteration of jail buildings, with great advantage both in economy and in the rapidity with which the works are carried out. They helped towards construction of the new jail at Benares which was completed in August. Results have, we are told, amply justified the expectations with which this form of prison employment was initiated.

The information vouchsafed under the heading "Mines and Quarries" is exceedingly meagre. Here is the whole paragraph:—

The following figures shew the demand, collections and balance on account of mines and quarries for the revenue year 1885-86:—

**AUTOMATIC BRAKES FOR THE N.-W. R.**—The North-Western Railway has now under consideration the adoption of some system of automatic continuous brake. A train is being fitted up in Calcutta by the Vacuum Brake Company; while in Lahore a train of thirteen saloon carriages, fitted up in Lahore by the Agent and Engineer of the Company with the new quick-acting Westinghouse Brake, ran a trial trip recently from Lahore to Raewind and back. It will be interesting to watch the results of experiments to be made on both the Vacuum and Westinghouse systems, and to learn what decision is finally come to by the Railway experts. Meanwhile, it is certain that the ordinary brakes now in use are not anything like sufficiently powerful to arrest within a reasonable distance trains which descend the heavy gradients obtaining on the North-Western at full speed.

**TRICHINOPOLY WATER-SUPPLY SCHEME.**—The Chairman of the Trichinopoly Municipality applied to Government for the services of a qualified person to investigate a water and drainage project for that town, but was directed to make his own arrangements for securing the desideratum.

Hence the advertisement that appeared in this journal. A large number of applications were received, but none of the applicants appeared to have the special qualifications required. Subsequently the Acting Collector succeeded in securing the services of Messrs. Oldham Brothers of Calcutta for the work "under circumstances which provided for all that could be desired in the way of special knowledge on the subject." Messrs. Oldham Brothers estimate the cost of the proposed scheme at 2½ lakhs of rupees. That firm will charge 3 per cent. on the outlay for preparing the detailed plans, and 3 per cent. for the execution of the works. We may have more to say on this subject hereafter.

**OOTACAMUND WATER-SUPPLY SCHEME.**—In the report which accompanied the estimate for the Ootacamund northern water-supply, it was stated that 188·65 acres of the catchment area of Marlimund reservoir would be cut off, because they were planted with tea, and therefore presumably contaminated with manure, and would be supplemented by 200 acres on Snowden, whose rainfall would be conveyed to Marlimund in a masonry duct. Rs. 1,000 were provided in the estimate for excluding the contaminated area, and Rs. 30,750 for bringing in the new supply from Snowden. This latter part of the scheme has been carried out with the result that up to date, instead of the 15 cubic feet per second which was the anticipated discharge, we have only obtained 5 cubic feet per second; and the Executive Engineer is of opinion that anything approaching the anticipated discharge from this area, can never be got, and that it will never compensate for the area which it is proposed to exclude at Marlimund.

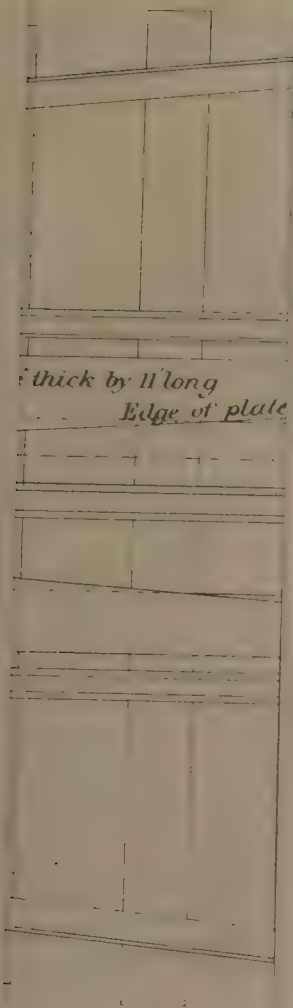
**ENFORCEMENT OF 55 YEARS' RULE.**—The Government of India, we are glad to see, perseveres in its determination to enforce the 55 years' retirement rule. What would be the use of making a Median and Persian Rule, only to break it, every now and again, and stultify itself, and lay itself open to the charge of favouritism, and give occasion to juniors in the services to gnash their teeth and blaspheme. The case of two officers in the Opium Department who are to be superannuated shortly has given occasion for these remarks. They have done good service; they are physically quite fit for work; and they, and some of their friends, seem to think this enforced retirement an unwarrantable hardship. That is natural enough on their part; but considering the block in promotion afflicting the lower grades of the Department in which they are serving, giving them an extension of service would be to inflict a hardship on many men, instead of only on two. Here, as in other matters economical "the greatest good of the greatest number" is the rule for conduct that ought to prevail.

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**THE BRIDGES ON THE S. M. R. MYSORE SECTION LINE.**—Four bridges on this line were carried away by the floods last year,—one, a twelve-feet beam bridge at Chenapatam, two twenty-four-feet beam openings at Mudder, six thirty-feet arches at Hebbala, near Mandya, and one twelve-feet arch near Seringapatam. These bridges have all been rebuilt, with the exception of the one at Hebbala, and this is fast approaching completion.

**SOME ANOMALIES.**—In Madras we find a Superintending Engineer, 2nd Class (*s. t. p.*), officiating as Chief





REPORT ON PERIYAR PROJECT WORKS FOR JULY 1888.—Very little work has been done during the month, the weather having been unusually bad, which has not only prevented coolies from coming in any large numbers, but has greatly interfered with the labor of those who are present. It has been almost impossible to make any progress with the buildings, which is the work most desirable to be pushed on at present. The whole of the officers' quarters are built and roofed in, but none of them are really completed. The office at the Periyar is in an advanced stage, and a commencement has been made with nearly all the remaining buildings, but not much has been done. A small quantity of blasting has been done in the water-shed cutting, but no important progress can be made there until the Muliya Panjan has been again diverted; it is to be regretted that by the carelessness of the subordinate left in charge during May the bank constructed last season for the diversion of this stream was allowed to breach,—an occurrence which might easily have been prevented, and a good deal of the excavation done last year has been filled up; the actual loss of work is not serious, but the delay is annoying. At the Periyar the only work done (except the small progress with the buildings) has been the removal of the earth on the escape and on the site of the dam; a fair amount of progress has been made with the former, the rock being now exposed in many places. An attempt is being made at reducing the rate of pay for labor, and also at the introduction of piece work; the latter has not as yet been very successful, except with regard to boring holes for blasting. The rate of daily pay has been reduced from six annas to five.

## Current News.

CAPTAIN J. C. TYLER, R.E., has been appointed Company Commander, Bengal Sappers and Miners.

THE telegraph has been laid from Abbottabad to Mansehra on the Oghi route for the Black Mountain Expedition.

A CONSIDERABLE find of petroleum is reported from Assam, but the matter at present is involved in considerable secrecy.

MR. C. L. GRIESBACH will not return from Kabul for some time, his geological explorations being postponed owing to Ishak's rebellion.

FROM Delhi, Jullundur, Meerut and other places come news of disastrous rain, which has caused widespread destruction to crops and houses and loss of life.

GOVERNMENT have sanctioned an estimate amounting to Rs. 45,500 for constructing workshops, and Rs. 1,802 for a gate office at the Bellary Arsenal.

THE Government of India have offered a thousand rupees prize for the best text-book on domestic economy and sanitary science suitable for the use of schools.

SERIOUS damage has been done by the floods at Saharunpur. The North-Western Line near the Jugadri station was breached 200 feet on the 21st September.

FINAL orders have been received for the amalgamation of the two sections of the N.-W. Railway. The Director's Office has returned from Karachi to Lahore.

THE amalgamation of offices on the North-Western Railway will, it is stated, effect a saving of from 50 to 60 thousand rupees per annum in the Audit Branch alone.

THERE have been, of late, a series of casualties among the employes connected with the tunnel works of the Khwaja-Amran extension, on the Sind-Pishin Railway.

AN inquiry has been ordered into the circumstances under which the steamer *Eden Hall* ran into the harbour wall at Bombay, displacing masonry, and doing other serious damage.

THE Singareni coal continues to improve with the depth, and quantities of really good coal from deep workings have lately been sent for use on the Madras and the G. I. P. Lines.

MAJOR GARWOOD, Superintendent, Military Works, Quetta, will take charge of the Military Works, Rawal Pindi, during the absence of Colonel Beresford Lovett, appointed to command the Royal Engineers and the Hazara Field Force.

THE earnings of the North-Western Railway during the first four and-a-half months of the current official year (1st April to 18th August) have exceeded by more than 15 lakhs of rupees those of the same period for the previous twelve months.

THE Rajpore Drainage Works are for the improvement of a large area of swampy land in the Hooghly and Midnapore districts, which lies for a great part of the year under water. The Government of India has just sanctioned six lakhs of rupees for the work.

NOTIFICATIONS are about to issue in the Public Works Department stopping all "incremental scales of pay," both for upper and lower grades, in the Railway Service. Appointments will in future be at fixed rates, higher pay only being obtainable by promotion as vacancies occur to higher employment.

MR. D. GAUNTLETT, Officiating Chief Engineer and Secretary to Government, H. H. the Nizam's D. P. W., is to receive an acting allowance of Rs. 300 per mensem in addition to his own pay from the time he took over charge from Mr. G. Palmer, who is now absent in Europe on leave. This is in accordance with the D. P. W. Code.

THE Railway Conference have got through a good deal of business during the past week. The subjects under discussion were circular tours in India; uniformity of issue of return tickets in through booking; concessions to owners of race-horses in carrying their animals to and from race meetings; the number of classes of railway carriages; uniform rates in through booking for several articles usually booked by passenger trains; the question of inter-communication between driver, guard, and passengers; and, finally, the revision of excess luggage and parcels rates.



## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

### INFORMATION WANTED.

SIR,—Will you, or any of your readers, very kindly inform me where I can get a small and clearly written practical book on the erection of iron girder bridges, say of spans ranging from 50 feet to 150 feet, with special reference to the kind and strength of staging necessary in each case.

X. Y. Z.

### MR. F. J. WARING, CEYLON RAILWAYS EXTENSION.

SIR,—I see a note in your publication of the 5th instant *re* the appointment of Mr. F. J. Waring to the Chief Resident Engineer-ship of the Ceylon-Haputale Railway Extension, and comment on this fortunate gentleman's salary and its great increase in the past 12 years. It is precisely this 12 years' work that has earned him, and rightly earned him, the increment. His facility in overcoming difficulties, his method, his acumen generally, and his zeal on that most difficult line, the Nanu-oya Extension, are his "fortunateness," and every professional visitor will endorse the action of the Ceylon Government in rewarding the man who has done such excellent work for the Colony.

Further, the appointment is not pensionable, so Mr. Waring is only receiving his deferred pay in advance.

It was my privilege to have worked under Mr. Waring.

September 13, 1888.

NANU-OYA.

### DEVICE FOR RE-RAILING VEHICLES.

SIR,—I send you a tracing (*vide* annexed illustration) from an unpublished work of Professor Waddell, shewing a device for re-railing vehicles, to be used at any time, such as a high bridge with curved approach, where a de-railment is probable and specially dangerous.

There are several places in India, notably the Sind-Pishin Railway, where it would be worth while to introduce the apparatus.

The arrangement is tolerably clear from the plate; a frog of ordinary rails guides the wheels back to the inclines, which guide them back on the rails. The outer incline begins further back than the inner, and the rise is greater and more rapid, so as to give the vehicle a cant towards its proper position.

The second incline, after the drop, is intended to re-rail a vehicle coming from the bridge, and would not be required if the apparatus is intended only to act in one direction.

This apparatus is, of course, only effective so long as the derailment does not exceed half the gauge. To protect the bridge in the event of a de-railment, exceeding this amount, it is necessary to add in front a ditching apparatus as shewn. The site chosen for this should be the nearest safe place.

F. E. R.

September 5, 1888.

### THE WORLD'S COMMERCE.

SIR,—In a published list of the world's big ports Antwerp, and Genoa and Bilbao, find mention, but there is not a line, a figure, the decimal of one even about Calcutta, Madras and Bombay. India has been blotted out of the statistical world apparently. Cardiff is the new king as far as British dominion is concerned. New York, the absolute dominion—world's eye and centre, and hub wheel and all the rest of it. Will it last? Can it last? John Law's Mississippi scheme was a mighty pretty thing in its way, and it sensibly helped in the revolution and an anarchy France has never recovered from since.

Eliminating Yankee assumption from the argument, it is satisfactory to be assured that "of course when values are considered" England is far ahead. An Englishman will probably incline to consider that value. Fair pay for good work is a primary essential of trade. We hope that Englishmen will always abide by and hold fast to this dogma. Increase of tonnage at Bilbao is referred to as phenomenal—New York and Yankee gas notwithstanding; and with reference to commercial growth "the increase in British steamers is more than double that of the foreigner." This statement should probably, however, be swallowed with a grain of salt. For "the table of foreign ships is only brought down to 1885, and those of Russia and Greece are not inserted for that year at all." What is the meaning of the word "Statistics." If they are not absolutely accurate they have in them faculty for doing a vast amount of mischief. It is quite conceivable that their misleadments may lead to more ill results than any

Hence the advertisement that appeared in this journal. A large number of applications were received, but none of the applicants appeared to have the special qualifications required. Subsequently the Acting Collector succeeded in securing the services of Messrs. Oldham Brothers of Calcutta for the work "under circumstances which provided for all that could be desired in the way of special knowledge on the subject." Messrs. Oldham Brothers estimate the cost of the proposed scheme at 2½ lakhs of rupees. That firm will charge 3 per cent. on the outlay for preparing the detailed plans, and 3 per cent. for the execution of the works. We may have more to say on this subject hereafter.

OOTACAMUND WATER-SUPPLY SCHEME.—In the report which accompanied the estimate for the Ootacamund northern water-supply, it was stated that 188·65 acres of the catchment area of Marlimund reservoir would be cut off, because they were planted with tea, and therefore presumably contaminated with manure, and would be supplemented by 200 acres on Snowdon, whose rainfall would be conveyed to Marlimund in a masonry duct. Rs. 1,000 were provided in the estimate for excluding the contaminated area, and Rs. 30,750 for bringing in the new supply from Snowdon. This latter part of the scheme has been carried out with the result that up to date, instead of the 15 cubic feet per second which was the anticipated discharge, we have only obtained 5 cubic feet per second; and the Executive Engineer is of opinion that anything approaching the anticipated discharge from this area, can never be got, and that it will never compensate for the area which it is proposed to exclude from Marlimund.

ENFORCEMENT OF 55 YEARS' RULE.—The Government

### THE INDIAN ARCHÆOLOGICAL SURVEY.

SIR,—It is to say the least, surprising that the Director-General of the Indian Archæological Survey should be allowed to fill in the Department as he chooses. There is one Assistant who is nowhere when he has to write, and simply can't write, English! Then there is another in Bombay, that has never even dared to appear in public in type. What some one else can do, and has done, the *Pioneer* told us a few months ago. Dr. Hulzsch has prudently not yet appeared in print in English—he is a German and presumably deficient in English. Dr. Führer's English is so limited that Dr. Burgess has to put it straight. The ex-S. P. G. Mission School-master at Umballa has not two ideas in his head beyond coins of Mahomedans and Sati funeral pillars. Poor Keith's place was filled up the other day by a man who was a draftsman in an Engineer's office in England and came out presumably to do better in India. The Director described his qualifications as something too really excellent to be lost. "He has made thousands and thousands of accurate Engineering plans and sections!" and, of course, he was put in. My dear sir, I really think this sort of thing ought to be put down; I must expose what is being palmed off on the public in the belief no doubt that it knows too little of the subject to be able to detect and expose the charlatany; it is impudence of the boldest sort to write such unmitigated trash as has been already published as Scientific Research.

INDIAN ANTIQUARY.

### WIND ENGINES FOR INDIA.

I.

SIR,—There is no country in the world whose inhabitants depend so much on the timely and sufficient yearly rains as India. If the usual rains fail, or if the rainy season has been below the average, there is a general cry of scarcity by the poorer classes; or, in other words, we may say, that the grain market of India is governed by the success or failing of the monsoons.

Rice, the chief food of the natives, requires the utmost care and attention in its growth, from the day it is sown to the day it is reaped, it has to be carefully looked after by the cultivators.



2" thick by 11' long

Edge of plate

## ING APPARATUS

PLATE V.

per 4: deep by 12 9' long he

Oak lumber 5.9.10 dapped in  
as shown

as shown

5'x4' angle iron guard rail

1<sup>st</sup> angle trimmed and bent

5.4 or 4e iron guard rail

Section on A. B.







Rice will not grow unless it has sufficient water, and it is owing to this reason that the failing of the rainy season causes such serious consequences. From the foregoing remarks it would appear that the natives are unable to control their food-supply, but are left to the mercy of the seasons.

Look at the famines that have visited India during the last century;—famines, which in their course have swept thousands away.

The question arises, could these famines have been prevented? If we look for an answer from the natives, they will tell you in the negative.

We in our own minds know that they could have been checked to a great extent if proper measures had been taken beforehand.

Although the English have been in possession of this country for over a century, we should have thought that India under British Rule would have improved, but while we see education and other branches of science advancing, the most important science, that of Agriculture, has been neglected, and we still find her in this department nearly the same as she was 200 years ago. Even to-day the ryot is seen plodding his way along with a pair of half-dead oxen yoked to an apology of a plough which just scratches the earth a few inches instead of turning up the rich under-soil. The same old-fashioned harrow with a few iron spikes stuck at the end of a bit of bamboo and other useless and primitive tools which he alone knows the use of.

Good implements and manuring are one of the important things required for good produce, still they are no use if the chief thing is neglected—and that is *irrigation*.

It is on proper irrigation that the whole produce of the soil depends, and it is for want of this that India has to thank herself for the disastrous famines that visit her periodically.

Some may think that what I state is absurd, and will reply, what! India devoid of irrigation. Look at the rivers she possesses! Look at the numerous streams that lead to these mighty rivers! Look at the thousands of tanks she can boast of in all parts of the country. Last, but not least—look at her fine canals. This is all very true I'll admit, but I am afraid it is a case like that of the Ancient Mariner—

"Water, water everywhere,  
And all the boards did shrink,  
Water, water everywhere  
And not a drop to drink."

This is just the case with India; she has magnificent resources of water, but what's the good of them if they are not made use of. How many thousands of tons is allowed to go to waste yearly which could have been utilized if proper appliances had been brought into play.

It's a sorry sight, and a sight which we see daily, of places where there are *nullas* of 10 and 12 feet of water, and only 500 yards from their banks, the earth is parched and the crops dying, and no effort made to utilise the precious liquid. *Perhaps* here and there along these banks we may find the usual native lift constructed from the hollow trunk of a neighbouring palm and worked by 3 to 4 men. The water on being raised is allowed to run along a narrow drain to some cultivated plot which lies either slightly below the level of the *nulla* banks or is in the same level, while other plots lying on higher levels never see a drop.

The above is about the only kind of engine which the Indian farmer boasts of for irrigation. It is true that the tanks in all parts of the country help a good deal, but even they are very often dry when the rains have failed.

It is a known fact that diseases rage to a greater extent in years when there has been a bad rainy season, the cause of which is easily explained. When the ryots find their crops dying, they have to breach the tanks for water, and the consequence is that they are dried up long before the rains set in again, and the villagers then become short of water for drinking and culinary purposes and are obliged to fall back on the dregs of any stagnant pool they come across. It is owing to this that cholera *et hoc genus omne* cause such havoc to life.

LEPIDODENDRON.

### THE FAILURE OF THE KALI NADI AQUEDUCT.

SIR,—I notice two letters in your issue of the 1st September concerning the discharge of the flood which destroyed the Kali Nadi Aqueduct, one from Mr. Hawkes, who thinks the discharge has been over-estimated, because it does not agree with his own calculations; and the other from Mr. Mittra, who thinks that it has been under-estimated, because it agrees neither with Colonel Dickens' formula nor with Rankine's factor. As I have not seen the previous correspondence, I do not know how much or how little information these gentlemen may have as to the flood in question, but the following may possibly interest them.

The flood was quite unprecedented within the memory of the oldest inhabitants, and destroyed buildings and uprooted trees of

considerable age all along the valley. It was produced by extraordinary rainfall over a large proportion of the catchment basin of (I quote from memory) upwards of 20 inches in 48 hours. It is very possible that the actual rainfall was greater than that recorded owing to the gauges having been allowed to overflow, but in one place a wholly reliable record of 18 inches in 24 hours was obtained. The rain was heaviest in the middle third of the valley, somewhat less in the lower third, and not exceptional in the upper third. The country is flat; the soil might be described generally as light sandy clay, but in places clay of the hardest description appears on the surface; excellent brick earth is found in many places, and in others there is loose sand; near the aqueduct it is very sandy, and speaking generally the valley is cultivated. Most of the branch drainage lines and the main line also in a few places have been improved by artificial cuts. The mean longitudinal slope of the valley may be taken at about 2 feet per mile; the total fall from the head to the aqueduct being rather more than 200 feet (I again quote from memory). There is no possibility of the flood having been augmented by the overflow from the Ganges or other adjacent drainage basin, the watershed is perfectly well defined and known.

Any calculation of the discharge from the basin area would, I take it, be considerably upset by the fact that the valley is crossed in several places by road and Railway, as well as by the canal embankments, all of which were breached, and all of which must have obstructed the flood before breaching so as to augment the maximum discharge when the accumulations were liberated. The discharge which is questioned was calculated not from any formula based on the area of catchment and the rainfall, but from observations of the velocity through an area of the breach in the aqueduct and its embankment, taken by a very experienced Engineer. Considering all the circumstances of the case, it will be admitted that this discharge is more reliable than any that can be obtained from any known formula for the discharge from the catchment area, and its value is in no way impaired because it does not happen to agree with such calculations. I hope these data will assist Mr. Hawkes in re-adjusting his formula to agree more nearly with the observed discharge if he thinks the case is one which can be formulated.

Mr. Mittra, in his closing para., asks a most startling question, whether "Rankine's factor of 40 cube feet per second per square mile is applicable in this country (India)?" Personally I am acquainted with only a small portion of India, but even in this small area the average rainfall varies in different localities in the ratio of 1 to 3, and the soil from the hardest rock to the lightest sand; surely Mr. Mittra would not propose to make the same provision for passing drainage in the various cases which might be presented; Rankine's factor was certainly not intended to be used in this way. Speaking generally a larger allowance is required in India than in England for an area of given annual rainfall, soil, and slope of country, &c., because the rainfall in India is more concentrated than in England, and larger quantities fall in a given time, and again any factor of this kind would vary in a given district with the size of the catchment basin since in very large areas rain is less likely to occur over the whole area at one time than in the case of smaller ones, and the factor can therefore be judiciously reduced as the area increases.

To revert to the Kali Nadi Aqueduct, there can be no doubt that the flood causing the accident was abnormal, and Engineering formulae are not designed to meet abnormal cases; the question as to how far provision for such cases should be made is one which it is impossible to bring within the limits of theory; it is essentially a practical one, and one which must be decided on the merits of each particular case. If in a multitude of counsellors there be wisdom, both Mr. Hawkes and Mr. Mittra may rest assured that the decision arrived at in the case of the Kali Nadi Aqueduct is sound.

N.-W. P.

PROTECTION AGAINST LIGHTNING.—Mr. Oliver Lodge says:—"A wire netting all over the house, a good earth connection to it at several points, and the plentiful supply of that barbed wire which serves so abominably well for fences, stuck all over the roof, and you have an admirable system of defence. Now let us see how far most people agree, and where they begin to branch out and differ. The old and amusing political controversy between knobs and points has disappeared. Points to the sky are recognised as correct; only I wish the advocate more of them, any number of them, rows of them, like barbed wire—not necessarily at all prominent—along ridges and eaves. For a point has not a very great discharging capacity. It takes several points to discharge readily all the electricity set in motion by a moderately-sized Voss or Wimshurst machine; hence, if you want to neutralise a thunder cloud, three points are not so effective as three thousand. No need, however, for great spikes and ugly tridents, so painful to the architect. Let the lightning come to you, do not go to meet it. Protect all your ridges and pinnacles, not only the highest, and you will be far safer than if you built yourself a factory chimney to support your conductor upon. At present the immediate neighbourhood of a factory chimney or steeple is not a safeguard but a source of mild danger."



## General Articles.

### ON THE ERECTION OF GIRDERS, SOHAN BRIDGE, PUNJAB NORTHERN STATE RAILWAY.

BY H. B. MOLESWORTH, LATE EXECUTIVE ENGINEER,  
P. W. D.

FOR spans Nos. 2 and 3 the trestle staging alone was used, but in span No. 4 it was modified so as to admit of the use of the one pier of staging which had stood the floods, and which was further protected by sand bags and a groyne, as shewn in plan. The general design of this staging, as well as the modification necessary to utilise the iron staging in span No. 4, is shewn in the accompanying sketches.

Span No. 5 was erected on the iron staging. This was protected by a groyne run from the high bank to pier No. 5, so as completely to cut the current off from span No. 5. This groyne was composed of sand bags, and answered admirably. The south 80 feet span was rolled across, and the north 80 feet span was built in position on a staging. The staging platform was composed of sleepers resting on metre-gauge flood opening girders, placed 8 feet apart. These girders are 24 feet in length, and five of them exactly fitted between the piers and rested on a stone corbelled out of the masonry, about 2 feet below the level of bed stone.

On the wedges being struck the girders rested at once on their bed-plates.

*Time occupied in erecting one span.*—Great difficulties were experienced from the intense heat, the frequent rains, numerous floods, and the constant illness of the Europeans employed on the work, but the chief delay was caused by the difficulty of getting up the staging. The trestles had all to be built, and in nearly every case spars had to be scarfed and fished together to get the requisite lengths. Again, in erecting the trestles some work had to be carried on in the bed of the river, such as transporting and fitting the trestles ready for hoisting, and every piece of timber used in the bed of the river had to be lashed, the stream running with such force that on one occasion it carried away, for a short distance, the tender of an engine that was being taken across, and could not be hauled out of the river bed in time.

The floods too were very sudden in their rise, so much so as to carry away men on no less than three occasions.

On the completion of a span of staging, every effort was made to make the girders safe, so that in the event of any extraordinary flood endangering the staging, they would be self-supporting.

No. 2 span was made safe in 80 hours.

" 3 "	" "	53 "
" 4 "	" "	34 "

I regret that I am unable to give the exact times employed in working on the No. 2 and No. 3 spans, but the No. 4 span was completed in 28 working hours, from the time that any portion of the girder was risked on the staging to the time that the top boom was bolted up.

The end pieces of the bottom boom were laid down, the girder "box ends" were rivetted to them, and the diagonal cross-bracings of the ends put on and rivetted up. The ends of the girders were then secured as shewn in the annexed sketch, as a high flood was running, and the staging was not considered safe. As soon as the water began to subside, operations were at once commenced at 6 A.M. on the 7th September, and continued until 12 P.M. by the aid of the electric light; commenced again at 6 A.M. on the morning of the 8th September, and at 4 P.M. the top boom was in place and bolted up, the struts and ties on, the bottom boom rivetted, and all the cross-bracings in position.

The pieces of spans Nos. 1 and 5 and the north 80 feet

span were taken down into the river bed and hoisted, steam winches being used for the purpose. The pieces of spans Nos. 2, 3 and 4 were run out on trollies on a temporary line laid over the completed spans, and the booms, &c., were taken direct from the trollies by a travelling crane made especially high, so as to stride over the completed girder and a loaded trolley on it.

I must mention the assistance and hearty co-operation I received from all the subordinates employed on the bridge. Mr. J. Alchin, Sub-Engineer, was in charge of No. 4 span when it was erected, as above stated, in 28 hours, and his large previous experience was of the greatest assistance to me. Mr. McReddie, Supervisor, was also of great assistance to me.

H. B. M.

### BICYCLE RUNNING.

BY A. EWBANK.

I.

It does not appear that either the Geometry or the Dynamics of the BICYCLE has yet received any attention from mathematicians. We propose, therefore, in some measure, to fill up this gap in our scientific literature. Our conclusions—to use a much abused word—will be practical. That is, our conclusions are fit for, and intended for, acceptance by amateur and professional bicyclists.

Although our treatment is geometrical as well as dynamical, yet it is in the dynamical aspect that we aim at viewing this beautiful machine. Our geometrical investigations are merely subsidiary to our dynamical diagnosis. Or, varying the simile, we may assure the reader that though at times we seem aimlessly to wander in some region of geometrical subtleties, yet none the less are we steadily wending our way unto the land of Dunamis.

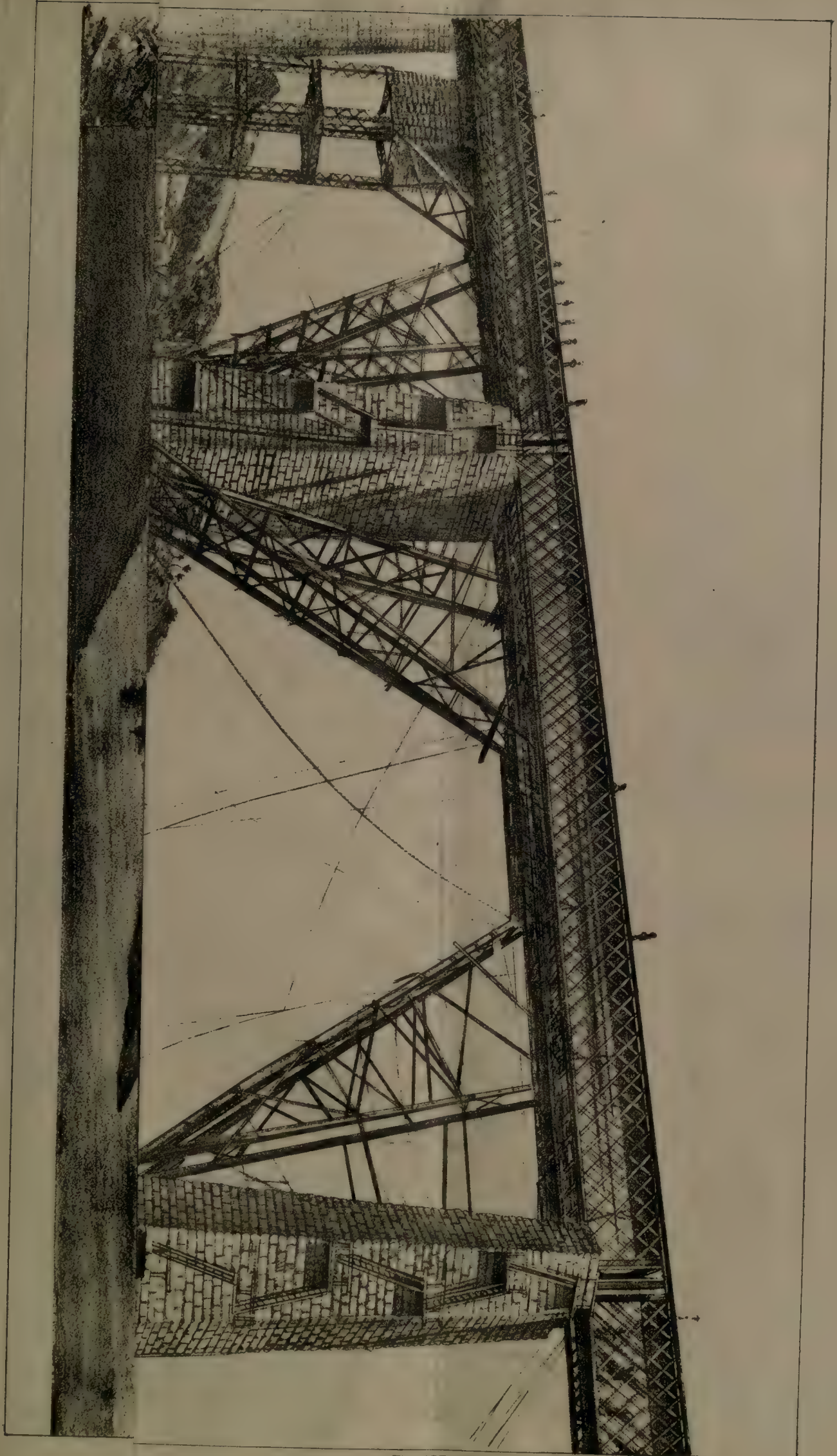
Although our investigations are offered to the public as the journal of a traveller who has visited a hitherto unknown country, yet we must, necessarily, to round our inquiry, and to make it complete, avail ourselves of certain already well-known facts and principles. The effect on the stability of any body of giving it a rapid rotation about an axis through its centre of gravity is well known to machinists and mathematicians.

Many intelligent men, not unacquainted with the scientific treatment of forces, are under the impression that the bicycle is sufficiently described in the following few lines: "A hoop can keep upright if it rolls rapidly. A bicycle practically consists of two hoops rolling rapidly. But the front hoop is furnished with a handle and, by turning this, the rider of the machine chooses his course at will."

Such in fact was the statement lately enforced on the present writer by a fellow traveller. This fellow traveller repudiated the suggestion that there was more to be said on the principle, or on the principles, of the bicycle. He had seen the bicycle often enough, and he knew very well that he had fairly and sufficiently described it. That fellow traveller represents the primeval cause of these papers being written. For the actual writer, after smiling to himself at the very imperfect knowledge possessed by the other, turned round on himself—so to say—and said to himself, "He knows next to nothing, but do you know all, or even nearly all, that concerns the action of the bicycle." When this question was once put by one-half of the writer to the other half, it presently was agreed to by both halves that there were some points in the bicycle that required a methodical investigation.

The writer was a tolerably skilful bicyclist some fifteen years ago; and he remembered enough of what he had then instinctively practised, when on a bicycle, to see that the bicycle should offer some interesting features in the way of Geometry and Dynamics. The instinctive or semi-unconscious skilfulness which a bicyclist gradually acquires, is a very curious characteristic of experts in many athletic amusements. In the concluding paper of





The "STAR" Press, 19, Lall Bazar, Calcutta.







this series, we shall return to this point. Meanwhile, we commence with some well-known principles and we gradually pass from them into matters that are, or may possibly be, unknown to the thinking or bicycling public.

If we place on an ordinary level road a hoop disc or wheel which has only the ordinary thickness, we find that the body can remain upright at rest, but that it is easily upset by any force that acts laterally. If we desire to use more technical, *i.e.*, more accurate or precise language, we may express ourselves as follows. A force applied to the hoop or a blow delivered in some direction taken at random may be represented as, or resolved into, three distinct forces or blows. These are called components. One acts perpendicular to the plane of the wheel. This force or blow is horizontal. It is the real upsetting force. Another component acts horizontally and in the plane of the hoop. This will set it rolling, but has no tendency to upset it. The third component acts in the plane of the wheel and vertically. Its tendency, if downwards, is to press the hoop more firmly on the ground. It has no tendency to upset it. We cannot say that it has no tendency to make the wheel roll. It may have such a tendency, and generally it will have. But this tendency will sometimes agree with and sometimes will oppose the rolling tendency due to the second component. The two latter components may be replaced by one force or blow *R* which acts in the plane of the hoop. This resultant *R*, as it is called, has no upsetting tendency. If we take into account the roughness of the road, we may say that *R* must tend to set the wheel rolling, unless it is entirely vertical, and also passes through the centre of the hoop. We are not compiling a treatise on forces generally, so we must, as far as possible, avoid all questions which do not bear upon the bicycle. We have then only to notice here that a hoop disc or wheel standing upright and at rest on an ordinary level road, is very sensitive to the disturbing action of a force whose line of action is normal to the plane of the hoop disc or wheel. In future, we shall only speak of wheels. A wheel can be acted on by forces that are applied at the centre or on the spokes. A hoop has—so to say—no inside, and if a force is to influence the hoop, the force must be applied at a point in the circumference.

When we have obtained our conclusions with respect to the bicycle, we will express them in language “understood of the people.” These conclusions may then be copied into popular manuals of the bicycle—or compendiums of sports such as the Badminton Library—should the bicycle ever be made a subject for a manual.

But while we are working out these conclusions, we must at times make plunges into lakes of Algebra and seas of Trigonometry and we shall suppose that some of our readers have sufficient mathematical knowledge to follow us through those depths. In the papers on the “Geometry of the Oblique Arch” great care was taken to reduce methods of solid Geometry into formulæ of plane Trigonometry. But then we were writing for a special class of professional men. We shall not in these papers introduce such simplifications, because they also mean considerable elongations.

Let us suspend a wheel, or indeed any body, so that it can swing without much friction about a horizontal axis which passes through the body and near to its highest portion. If we let the body settle into what is called its position of equilibrium, we shall find its centre of gravity in a vertical plane passing through the axis of suspension. Or, we may say that the C. G. is exactly under the axis.

If we disturb the body from its position of equilibrium it will—assuming the absence of any appreciable friction at the axis—endeavour to regain its former position, and will execute a series of oscillations which become successively feebler until it is again at rest in the position of equilibrium. Such a body is said to be in a position of stable equilibrium.

Let us now shift the axis to a position near the lowest part of the body. The body may now with care be poised over its new axis with the C. G. vertically over the

axis. Let us give the body a small displacement. It will no longer endeavour to regain its former position. On the contrary, it will recede further and will ultimately find some entirely different position in which it will come to rest. This wheel or body was in a position of unstable equilibrium.

The wheel, which was at rest and standing upright on an ordinary level road, was in unstable equilibrium. Let *R* be a small blow delivered normally to the wheel, and through a particular point, say, for example, its centre. Let *R* be just sufficient to upset the wheel.

Now replace the wheel in an upright position and start it rolling upright with a considerable velocity. To fix the ideas let it move in a line due north. The moment after it starts let us deliver at the same point as before, *viz.*, the centre, and in the same direction as before, *viz.*, in the east-and-west line a blow *R* of the same intensity as before. Also to fix the ideas, let *R* be acting towards the west or towards the left hand of the man who, after starting the wheel, watches it rolling. The wheel will acknowledge the blow by a suitable courtesy, *viz.*—suitable inclination. But now a difference is observed between this and the former case. The wheel will now not fall flat as it did in the former case. We shall see it endeavouring, as it were, to resist falling. A series of oscillations or “wobbles” will be produced. If no further blows are delivered, the wheel will continue to roll. It will not, however, keep the north line. It will begin to bear to the west, and will, for its track, trace out some kind of a curved line which at first is not very different from an arc of a certain circle. The centre of this circle will be on the ground at a point some distance due west from the position of the wheel at the moment the blow *R* was delivered.

We see, therefore, that the wheel has in some way improved its stability. It has now a less tendency to fall down and to lie flat, than it had when it stood upright and at rest on the level road.

## SEWAGE REMOVAL AND GAS-POISONING.

BY J. WALLACE, C.E., BOMBAY.

### II.

THUS the whole of the contents of the receiver are discharged by a valve which remains full open until the floor is drained and then closes until another charge has accumulated. The upper float may be adjusted to open with the accumulation of twelve or any other number of hours. By the aid of this short description you will be able to follow what takes place in the working model before you. A glass tube is attached to the vessel representing the receiver so that the level of the liquid may be observed from without, and a pointer is attached to the valve rod so that the movement of the valve may be evident to the audience. When the liquid in the glass tube rises to a certain point, a sudden movement of the pointer tells us that the valve is open, and immediately a rapid fall of the liquid indicates a free escape by the discharge pipe. The glass tube now indicates that the vessel is empty, and at the same time the pointer marks the closing of the valve. The action of sewage upon iron being more rapid than that of potable water, the whole of the metal work of this apparatus is coated with a hard vitreous enamel, and the guides of the rod are of glazed earthenware. There are thus no two metallic surfaces working together in the apparatus, and the risk of rust locking is avoided. One notable advantage of a pneumatic system is the small amount of excavation necessary for the laying of the pipes. Irregularities of level of several feet have no prejudicial effect on their efficiency, so they may be laid very near the surface of a street. If a leak should occur, it does not result in an outflow of sewage, but only an escape of air into the pipe and a reduction of effect of the pump which soon attracts attention. If any receiver or valve should



require repair, the receiver may be emptied by means of a hand pump and hose into the next one, and thus the offensive sight and smells, resulting from the carrying of sewage by hand or by open carts through the streets, may be avoided. Again, if the discharge of sewage depends upon the movement of the tides, the receiver provides the means of storing sewage until the proper moment arrives for sending it out to sea. Until the possibility of utilising it as a fertilizer is proved beyond the possibility of a doubt, the sewage of Bombay will be most safely disposed of in the sea, not by turning it into the shallow water near the shore, but by leading it out to such a distance that it cannot return in any appreciable quantity. At present the sea breeze has frequently to traverse a belt of foul smelling water before it reaches the town, and it comes to us laden with anything but ozone or iodine. The outfall at Love Grove, through which part of the sewage escapes into the sea on the western side of the island, seems, by reason of the conformation of the bottom of the sea, to be well chosen as the point at which all the sewage of Bombay may, within safety, be discharged. There exists within a mile and a half of the shore an ocean current which changes twice a year, flowing northward for five months and southward for seven months. This current, with the aid of the tides, should do all that is necessary for the dissemination of the sewage of the town in the sea in such a manner that the westerly winds should not be appreciably affected by it. In this instance the climatic conditions are favorable to the work, for, although salt water is no antiseptic, the myriad forms of animal and vegetable life which swarm in tropical seas, combined with the action of the atmospheric air on the surface, and in suspension in the water, together with the sun's light and heat, all assist in the assimilation and utilisation of organic refuse. The works of water-supply and of sewage removal have so many points of contact and so many joint interests, that they should always form part of one administrative body, instead, as is often the case, of representing rival factions, each seeking to discredit the other. A copious water-supply, without a corresponding system of sewage removal, only augments instead of diminishing the causes of disease. The disposal of sewage appears in India to have had much less of that thorough attention given to it than has been bestowed upon water-works and railways. Some sewage works speak eloquently of the engineer without the chemist, while others savour of the chemist almost exclusively. It is difficult to say whether mechanics or chemistry is the more important science in questions of sanitation, but it is certain that no sanitary work is well done which has not been thoroughly studied from its chemical as well as from its structural point of view. It has been the fashion to send engineers from India to England to study questions of sanitation, and after examining the most successful works to be found there or in any other temperate country, they attempt to reproduce them here. Now the first reason for the success of any system whatever is its strict harmony with all the surrounding conditions that are likely to affect it; and as the conditions of rainfall, temperature, climate, and custom in Bombay resemble those of no country in Europe, it is safe to say that the most successful system of sewage removal in England would fail here just because it succeeded there, if copied exactly. All sanitary questions, in order to be treated successfully, must be studied on the spot so that no important element may be neglected. This remark applies in its greatest force to a town like Bombay, situated on a limited area, and having a rapidly increasing population, the density of which is already attracting the attention of our sanitary authorities. The safe limit of density of population depends so much more on the quantity of sewer gases present in the air than on the quantity of carbonic acid gas produced by the respiration of the people, that until a standard of cleanliness is established and maintained, no one can say how many individuals may live in health on one acre of

town area. This can only be attained by the rapid and complete removal of all sewage and refuse matter from contact with the air. The attempts that have been made to dispose of solid refuse, such as stable bedding and street sweepings by burning in Bombay, afford a very good example to illustrate what has just been said regarding sanitary notions imported direct from England. A rubbish furnace or "distructor" was built in the town on the model of one in use at Burnley, burning rubbish composed largely of coal cinders. The Bombay rubbish is composed, for the greater part, of damp hay and straw; the failure of the furnace to burn it satisfactorily was, therefore, inevitable. An analysis of the Bombay "kut-chra" would have shewn the furnace to be unsuitable before it was built. Another experiment has since been made on the Flats with a view to improve on the first attempt. The furnace contains two floors of fire bars, one directly above the other. Their total grate area is 70 square feet, and the chimney has an area of 1 square foot with a height of 60 feet. When both fires are lighted, the lower fire burns the air that should feed the upper one and combustion is retarded, resulting in dense smoke. A boiler chimney, 60 feet high, to serve 70 square feet of grate surface, would require to have an area just fourteen times that of the new furnace on the Bombay Flats, and it is almost superfluous to say that it is useless for its intended purpose. In order to succeed in the construction of a rubbish furnace, the designer must begin with an analysis of the material to be burnt; and if this analysis is properly used, the proportions of the furnace will develop themselves. The average ashpit rubbish burnt in England never contains more than 47 per cent. of moisture, and it is all screened before being burnt in order to separate incombustible matter. Average fish garbage contains 82 per cent., and the worst garbage, of which data have been published, contained 93 per cent. of water. The last example must have been unusually wet as the bodies of dead land animals contain at the most 75 per cent. Bombay rubbish consists principally of straw and stable bedding, which rarely contains as much as 66 per cent. of water unless it has been exposed to the rain. With this quantity of water, equal to one part of rubbish to two parts of water, it will burn freely if held up loosely in the air, but it burns very slowly if ignited in heavy masses which exclude the atmosphere. It is, therefore, plain that the construction of the Bombay rubbish furnaces is not adapted to their intended purpose. At Warrington and at Manchester the rubbish is used to raise steam for the manufacture of manure. At Nottingham it produces power for electric lighting, and at Bolton it furnishes power for grinding mortar. At Ealing, Southampton, and Battey, the rubbish furnaces raise the steam for pumping sewage, and this appears to be the natural destiny of the Bombay rubbish. The history of the rubbish furnace is not without its humorous element. At Bradford the borough analyst had occasion to test the smoke escaping from the local furnace, and for this purpose he absorbed in alcohol, a small portion of the gases issuing from the fire. The alcohol, after a certain exposure, was diluted and was found both in taste and smell to have a decided resemblance to Scotch Whiskey. Such a vast field of possibilities seems to be opened up by this simple experiment that it is well worthy of the attention of the Abkari Department. The practice of levelling up waste land in the neighbourhood of habitations with vegetable and animal rubbish cannot be too strongly condemned. The refuse cut off from direct contact with the atmosphere decomposes mostly by putrefaction, and will continue for years to give off the most unhealthy emanations. Many acres of land on the flats have been thus treated and rendered unfit for building purposes for years to come. This practice is now prohibited in the vicinity of large towns in Great Britain, and the objections to it have additional force here on account of the climate. The use of iron pipes for the transport of sewage is one of the inevitable results of modern sanitary research, and



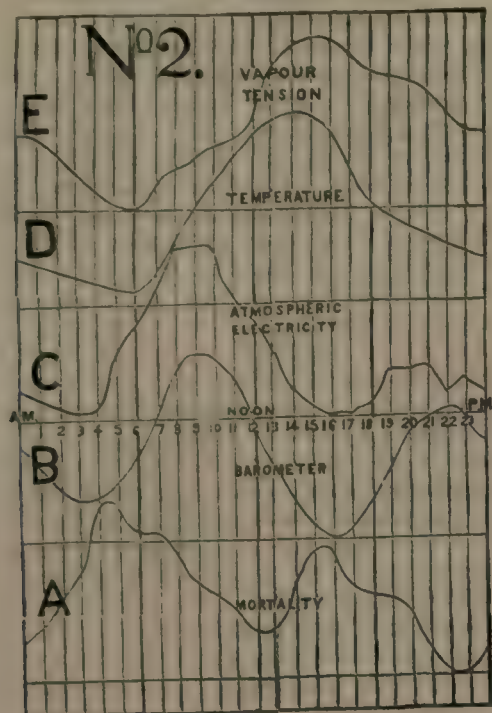
this mode of transport will find steadily increasing favor in large towns and in places where the levels offer difficulties in the way of an outfall: The cost of the mains will, in many cases, be found to be less than that of masonry sewers, while the cost of maintenance should be less on account of the smaller risks of fouling. The reduced size of the iron sewer naturally involves pumping so as to insure a maximum speed of current; and this accelerated method of transport under various forms is known generally as the pneumatic system. In Brussels and in various other towns on the Continent of Europe sewage is withdrawn from cesspits by means of a flexible hose attached to a cylindrical tank on wheels of perfectly air-tight construction. When the air within the cylinder is withdrawn by means of a steam or a hand pump, the sewage rises and fills it, and thus the transport is effected without causing any sensible odour in the streets. This method of removal is in partial use in Cairo at present for the transport of sewage between the cesspits of the town and a manure manufactory situated to the south of old Cairo. Sewage, without admixture of sullage, may be taken straight from the houses of a town into collecting mains and pumped to a manufactory, as is practised at Amsterdam under the Lieurnur Patents. This method of treatment allows the sewage to be converted into a valuable manure, at the smallest possible cost, by means of an apparatus closely resembling that employed for the manufacture of sugar. This process has been successfully carried out by the inventor, Captain Lieurnur, but the Town Council of Amsterdam, four years ago, gave it as their opinion that a system, which only disposed of the sewage of the town and which rejected the sullage, did not fully meet their requirements. This objection would apply in still greater force in a country where the temperature causes a rapid decomposition in sullage containing animal or vegetable matter. The Shone system, the invention of an English engineer at Wrexham, has, during several years, been gaining an increasing measure of public confidence. It may be briefly described as a series of air-tight receptacles of cast-iron, each receiving the sullage and sewage of a certain number of houses. The liquid flows by gravity to the receptacle or cesspit which communicates with the main (iron) sewer by means of a pipe with a valve. In addition to the sewage mains there is a second service of smaller pipes containing compressed air, which is the motive power used for propelling the sewage to its destination. When a cesspit is full, the rising of a float opens the compressed air valve, and the cesspit is emptied by the pressure of air on the surface of the liquid. A falling weight closes the air valve as soon as the cesspit is empty, and the operation repeats itself as often as is necessary. This apparatus is in successful operation at the Houses of Parliament, Westminster, at Southampton, at Eastbourne, and elsewhere. It is at present being applied at Rangoon, where its suitability in tropical climate will be thoroughly tested on a large scale. It may be safely predicted with regard to this apparatus that whatever modifications may be required in its details to suit local necessities, the general principle involving the use of iron pipes and pumps for the transport of sewage can only obtain a more decided recognition. In spite of much that has been done to ameliorate the sanitary condition of Bombay, and to reduce its rate of mortality, the result has been far from satisfactory, owing partly to the application of imperfectly planned schemes, and partly to the complete indifference of the native population to all sanitary precautions. In the matter of personal cleanliness the native has very little to learn from the European, but in all that regards the healthy condition of his surroundings he is profoundly ignorant, it seems as if all matters relating to sewage and its influences are looked on by him as affairs which only concern the lowest and most despised caste in his community.

Although the main streets are kept in good order, the

lateral streets leading from them are in many cases equal for filth and foul smells to any slum in Cairo or in Jerusalem. From monsoon to monsoon, through the dry season, the waste water of the houses is thrown from doors and windows into the unpaved streets; and waste vegetable matter, after lying indoors until its odour has become too strong for the not too sensitive inhabitants, is tossed out to await the arrival of the scavengers. In addition to all this the latrines constructed by native builders for storied houses are of the worst possible kind from a sanitary point of view. A section of the filthiest sewer set on end is the only fair description that can be given of them, and through this air shaft, lined with putrid sewage ferment, pass daily large volumes of poison-laden air to be breathed by the ignorant and unfortunate inhabitants. The sickly appearance of the women and children in such neighbourhoods is an unfailing indication of their surroundings; their habits being much more sedentary than those of the men of their class, they are more constantly under the influence of the gaseous poisons surrounding their dwellings, and the result is, that there are annually more lives sacrificed to these causes than were ever claimed by the custom of *Suttee*, now abolished by law. We have regulations by virtue of which, if a man fails to execute the necessary repairs in his house after due notice has been given him, he is held criminally responsible for any fatal accident that may arise in consequence of his neglect. A legal remedy against house-proprietors in respect of sanitation is equally needed, for their responsibility does not end with their own persons nor even with their families: it extends to all those individuals who come within reach of any centre of infection belonging to the proprietor. It may be urged that the difficulty of bringing home conclusive evidence in such cases would render legislation almost impossible, but a recent case which was tried in Glasgow, and reported in the *Times of India* of the 27th June, proves in a most satisfactory manner that house-proprietors can be punished for criminal neglect of sanitary precautions. "The proprietors of a house in Glasgow were found liable in £100 of damages to one of their tenants on account of the death of his only child, a girl of seven, from diphtheria caused by bad drainage. The Sheriff found that for several months previous the house had been in an insanitary condition through faulty condition of the drains, but that the defenders and their factors, though frequently applied to by the pursuer to have them put in order, and eventually directed by the sanitary authorities to do so, deferred having the drains put right till after the death of the child. A warning of this kind to Bombay landlords would not be amiss." The house proprietors in Bombay are a wealthy and influential class, their capital is well invested, and yields a most satisfactory return, and, generally speaking, they are totally ignorant of sanitary matters, according to their experience, sewers, latrines, and the foulest of smells are inseparable. But if the magistrates of Bombay should become as strict as those of Glasgow, they would, no doubt, be smitten with a very strong taste for sanitary science, and eventually they would come to know it as thoroughly as any other subject to which they give their serious attention. I have already referred to the influence of varying atmospheric pressure on the occlusion or discharge of gases from decomposing organic matter. With a view to give to this subject the prominence it deserves, I have prepared the diagram No. 2, containing curves illustrating the diurnal changes that take place in certain natural phenomena, of which careful records have been taken over considerable periods. The diagram is divided by lines into twenty-four vertical columns representing the hours of the day and night, and the curves traversing these lines illustrate the variations with regard to time and relative magnitude of the phenomena they illustrate. If it is true that admixture of gases from putrid matter with the air we breathe has an injurious effect on our health



the amount of injury will bear some proportion to



the amount of admixture. And granting that the change of barometric pressure has a direct influence on the rate of discharge of putrid gases, their result should be traceable among sick people, who are generally more sensitive to such influences than those in good health. Curve B represents the mean daily variation of the barometer during a period of six years, showing that the maximum pressure occurs at 10 a.m. and 10 p.m., and the minimum pressure at 4 a.m. and 4 p.m. The latter hours are those during which foul smells from the drains and sewers are most noticeable. Curve A is made up from the registers of mortality at the Jamsetjee Hospital, Bombay, covering a period of nearly four years. Only deaths from sickness have been counted, and all deaths from accident, violence, or poison have been eliminated. A glance at the curves A and B reveals a very remarkable coincidence between the periods of low atmospheric pressure and of maximum mortality. The lowest barometric pressure is in the fourth hour of the morning and the highest mortality is in the fifth hour. In the afternoon the lowest barometric pressure is between the fourth and fifth hour, and the maximum mortality between the fifth and sixth hour. The mortality in the morning is, however, considerably greater than that of the afternoon, although the afternoon pressure is lower than that of the morning. The explanation will, I think, be found in curve D of diurnal temperature, which finds its lowest point between five and six in the morning. This is the period of greatest radiation from the earth's surface. The gases escaping from the sewers and drains and from decomposing matter are suddenly cooled and lie near the surface of the ground until they are dispersed by the sun's influence. We have thus the exact reason why sleeping at or very near the ground level is so often dangerous in hot countries, and also why the Bombay atmosphere may be more unwholesome in the early morning than at any other part of the day. Curve E representing the mean daily variation of vapour tension in the air of Bombay during a period of six years, finds its lowest point at five in the morning. This is due to the influence of the temperature at the time, which controls, more than any other single influence, the amount of vapour held in suspension in the atmosphere. The large amount of vapour of water contained in the air during the greater part of the year exercises an important influence on the climate and on the inhabitants. This vapour lies like an immense mantle over the town,

protecting it from those extreme changes of temperature that are to be found in the drier air of the interior. Its effect on the human body is to retard evaporation from the surface of the skin and to increase our sensation of heat in the air, although, in fact, we feel our own bodily heat, of which the escape is slightly retarded. The vapour of water in the air is very favourable to all vegetable growth and also to putrid decomposition on account of the solvent power of distilled water, of which the vapour is composed, on all organic and even inorganic matter. The curve of atmospheric electricity, marked C, is the one of which the least is known regarding the influence on the human system. It is frequently in close hamony with the barometric line, but it is at the same time so erratic that no true theory has so far been deduced from its movements. It is quite possible that the sensations some people experience previous to a storm, and which are popularly attributed to electrical agency, are due to the increased impurity of the air caused by low barometric pressure and a stagnant atmosphere. There is one additional curve required to complete the series. It is the curve of air analysis during the hours of day and night, and although the work, in order to be of value, would have to be repeated over a considerable period, it is well worth the trouble in the face of the probability that it would coincide exactly with the barometric curve. While on the subject of air analysis, I would suggest one more experiment in series :—The analysis of the air contained in a large clean earthenware vessel inverted over ground floors of various materials in order to ascertain the nature and quantity of the gases that rise through them from the earth. The diagram No. 2 represents a series of natural phenomena, a thorough knowledge of which forms the very foundations of all sanitary work. We observe that the hour of greatest mortality is one during which we are, most of us, asleep, our vitality is lower, the pulsation less active, and the system more susceptible to unhealthy influence than during the day. We cannot, therefore, be too careful in the choice of our sleeping accommodation, and we cannot be too particular with regard to its surroundings, for, in case of sickness, it is there that we must pass the time until we recover. If our hospitals were subjected to a strict investigation, it would be found that in many of them the doctors have not only to combat the effect of disease, usually in an advanced stage, among the patients, but to fight with an adverse series of natural laws in which the odds are terribly against them. The external influences which may affect a sick man are much better known and understood to-day than those acting within him. There is, therefore, no excuse for the absence of any of those essential provisions upon which the healing art so much depends. What, for instance, is the good of the outlay on the structural decoration of a hospital surrounded by dusty streets full of traffic, or built on malarious soil, if it has no provision for taking its air supply from a height of sixty or eighty feet above the ground, and even for filtering it in certain cases. A building of one storey with such an appliance would have all the advantage of an upper storey in addition to a constant supply of air under perfect control. Again, what does the public benefit generally by hospitals in which people are cured in tens, built with money acquired in cotton mills in which the atmosphere is notoriously injurious to the health of hundreds of work-people. Hospitals, prisons, public and private buildings alike fail in their first essentials if the air within them is under no control either as to temperature, circulation or purity. In India, where the activity of all the forces of life and decay are at their highest development, the best efforts of our clearest knowledge can find no more worthy field of usefulness than inducing or removing the causes of disease. Meteorological and chemical science can tell us all we require to know regarding the changes that take place in the air we breathe, and constructive science is ever ready with its vast resources to adapt the laws of nature to our use and benefit.

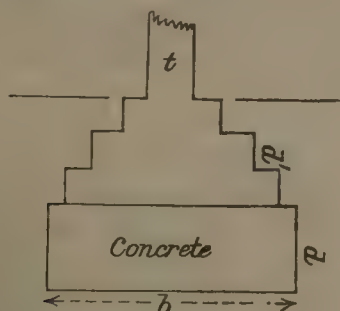


# TREVOR'S FORMULA FOR CALCULATING THE BREADTH OF FOUNDATION WALLS.

As great difficulties and some failures had occurred from time to time in the construction of important buildings in the Presidency of Bengal in consequence of the unequal subsidence of the soil under the foundations in different parts of the same building, the accompanying formula was circulated in August 1869 by Major (now Major-General) W. S. Trevor, R.E., then Superintending Engineer Presidency Circle, Fort William, to determine with sufficient accuracy for all practical purposes the breadth to be given to the foundation walls in order to produce a uniform or any desirable pressure on the soil irrespective of any differences of weight in the superstructure.

"To make use of this formula, it will be necessary to calculate the weight of every wall in tons per running foot allowing 20 cubic feet of brick-work or concrete to the ton and adding the weights of floor, roof, &c., to be borne by each wall. In the case of storage godowns it will be necessary to allow also for the weight of goods stored; and the weights are to be calculated as acting on the ground level, that is, at the level at which the foundations begin to splay. The weights being determined as above the only other points to be decided before working out the formula are the depth of the foundation and the pressure to be put on the soil. These will of course be determined in each case from the results of examination after the ground has been opened out. In single storied buildings of pretty uniform construction it will not be necessary except in rare and peculiar instances to go to this calculation as the pressure on the soil will generally be slight and sufficiently uniform for practical purposes."

Let  $W$ =weight in tons per running foot of wall in superstructure above top of footings.



$w$ =weight in tons it is desired to put on each square foot of soil under the foundation.

$d$ =thickness of concrete in feet, it is desired to put under the foundation.

$d'$ =depth in feet of brickwork to footings in foundation.

$t$ =thickness of superstructure in feet at the point where it rests on the footings in foundation.

$b$ =breadth of foundation on top of concrete it is required to find in order to make the pressure on the soil equal to  $w$  tons per square foot.

Then actual weight on ground level per running foot of the wall of breadth  $b$

$$= W + \left\{ bd + d' \frac{b+t}{2} \right\} \times \frac{1}{20} \text{ tons.}$$

The weight that is desired to be put on the same area =  $w b$ .

$$\therefore W + \left( bd + d' \frac{b+t}{2} \right) \frac{1}{20} = w b.$$

$$W + \frac{d't}{40} + \left\{ \frac{d}{20} + \frac{d'}{40} \right\} b = w b.$$

$$(40 w - 2d - d') b = 40 W + d't$$

$$\therefore b = \frac{40 W + d't}{40 \left( w - \frac{d}{20} \right) - d'}$$

Let  $W = 7$  tons  $d = 3$  feet,  $d' = 5$  feet,  $t = 3$  feet and  $w = 1$  ton.

$$\text{Then } b = \frac{40 \times 7 + 5 \times 3}{40 \left\{ 1 - \frac{3}{20} \right\} - 5} = \frac{280 + 15}{34 - 5} = \frac{295}{29} = 10.17 \text{ feet.}$$

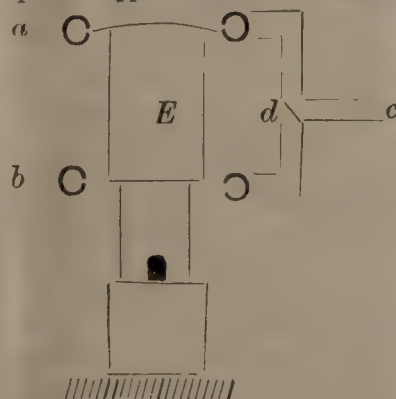
If in the above example the concrete were omitted and the brickwork splayed to the full depth  $d + d' = 8 = d'$

$$b = \frac{40 W + d't}{40 W - d'} = \frac{40 \times 7 + 3 \times 8}{40 - 8} = 9\frac{1}{2} \text{ feet.}$$

## MINING IN GREAT BRITAIN.

(From our own Correspondent.)

A NEW method of testing mining safety lamps is being introduced at some of the leading collieries. The apparatus is very simple, and the principle of the construction depends upon the application of an explosive current of lighting gas



and air upon certain parts of the lamp. In the case of a colliery where the well-known and useful "Marsaut" lamp is in use, the apparatus would take the following form. The lamp  $E$  is surrounded by two circular rings of iron tubing  $a$  and  $b$ , connected to the supply tube  $c$ , as shewn, with a distributing valve at  $d$ . The inside of each of the rings is perforated

with a number of holes about  $\frac{1}{8}$ th inch diameter, pointing towards the centre. A blowing fan is used, with two inlets one of which is connected to the gas main, and the other is open to the atmosphere. When lamps are being tested, the fan is kept running, (the admission of gas being closed), so that the air may issue from the holes in either ring at a speed of about 500 feet per minute. The lamp to be tested is lighted and placed between the rings  $a$  and  $b$ , as shewn in the figure, and the gas turned on, until an explosive mixture of gas and air is formed in the fan; the current of air is then turned by means of the valve  $d$  alternately into the upper and lower rings, and, finally, by holding the valve  $d$  in the middle position into both rings simultaneously. The test appears to be a very trying one, and it is improbable that an imperfect lamp could escape detection.

A committee is now enquiring into the practical merits of the scheme for the construction of a toll free canal to connect Birmingham with the Thames, Severn, Mersey, Trent and Aire navigable rivers. The scheme is in an incipient state at present, but it is hoped that an influential committee will be appointed to confer with the various local authorities and the Government upon the question. It is suggested that the existing canals should be extended to a minimum width of 60 feet and depth of 11 feet, such a navigable channel would carry vessels of 300 tons burden, and the estimated cost will probably reach several millions of pounds. It is hoped that the Government will be able to give the requisite powers to the local authorities for the purchase of the existing canals, and aid them with the use of a considerable proportion (if not all) of the necessary funds. Free transport on canals is as essential to the general welfare as free transport on highways.

The Hasard Collieries (Belgium) were sunk in 1842 by M. d'Andrimont. The output in 1886 was 232,742 tons, 961 men being employed in the mine and 273 at bank. A notable feature of these collieries is the use of Plom and d'Andrimont's new system of working. By this system the coal is neither "kirved" nor "nicked." After the shot hole (about  $1\frac{1}{2}$  inch in diameter) is bored about 4 feet into the middle of the coal seam in the ordinary manner by a machine drill, the "Excavator" is introduced and rotated by means of a ratchet brace, until a large chamber is formed at the far end of the hole. The excavator consists of a hollow tube containing a long screw carrying a pair of blades at one end, and is so arranged that the blades can be forced outwards. The coal is reduced to powder by the action of the blades, and is removed from the hole by the screw. When the chamber is say a foot in diameter, it is charged by means of a copper tube having longitudinal slits facing into the chamber. The hole is stemmed by a wooden plug passing through and closing the



hole at the axis of the chamber, and the outer end of the hole is filled with clay. The system affords several advantages: The danger is avoided of the men being injured when under cutting or kirving the coal, or in stemming which is done upon the wooden plug, and not upon the powder. The cost of working is reduced from 10 to 50 per cent. according to circumstances, and the headings are driven with great rapidity. The gases produced by the ignition of the powder do not affect the roof or thill, and less timber is required. The produce of large coal is largely increased; this is due to the absence of kirving and nicking; but the chief cause is the special form of the shot hole, which does not break the coal in the ordinary manner, but it is detached and moved forward a few inches in large blocks. About 60,000 tons per annum are produced by the use of this system at the Hasard Collieries in seams varying from 2 feet to 4 feet in thickness. The inventors have tried the system with some success in the North of England and Lancashire. The output per workman being in some cases increased about 66 per cent.

The North of England, Midland and South Wales Mining Institutes have recently appointed a joint committee to experiment upon the various systems of mechanical ventilators used in mines with the view of determining their relative efficiencies. Their programme of experiments is a most searching one, and their report will probably decide the question so frequently asked and never definitely answered—What is the best ventilating fan for my colliery? The formation of this committee was initiated by the North of England Institute, whose members are to be congratulated for their energy in taking such a step, as it will tend to bring the three institutes into closer connection.

## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

Madras, September 18, 1888.

Colonel J. O. Hasted, R.E., Chief Engineer, 1st class, is granted special leave for six months, with effect from 12th October 1888 or date of embarkation from Bombay.

Mr. J. W. Rundall, Superintending Engineer, 1st class, is granted special leave for six months from 1st October 1888 or date of departure.

Colonel H. B. Mead, R.E., to act as Chief Engineer and Secretary to Government, Public Works Department, during the absence of Colonel Hasted, R.E., on leave, with the temporary rank of Chief Engineer, 1st class.

Mr. G. T. Walch to act as Chief Engineer for Irrigation and Joint Secretary to Government, Public Works Department, Irrigation Branch, *vice* Colonel Mead, R.E., with the temporary rank of Chief Engineer, 2nd class.

N.-W. P. and Oudh, September 22, 1888.

#### Irrigation Branch.

His Honor the Lieutenant-Governor, North-Western Provinces, and Chief Commissioner, Oudh, is pleased to order the following promotions and reversions, with effect from the dates specified:—

Mr. A. H. Barron, from Executive Engineer, 1st grade, sub. *pro tem.*, to Executive Engineer, 1st grade, permanent rank, consequent on the retirement of Lieutenant-Colonel Ross, R.E., with effect from 2nd July 1888.

Mr. W. J. Wilson, from Executive Engineer, 2nd grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, permanent rank, consequent on the retirement of Lieutenant-Colonel Ross, R.E., with effect from 2nd July 1888.

Mr. A. C. Evans, from Executive Engineer, 3rd grade, sub. *pro tem.*, to Executive Engineer, 4th grade, permanent rank, consequent on the retirement of Lieutenant-Colonel Ross, R.E., with effect from 2nd July 1888.

Mr. J. H. A. Ivens, from Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 4th grade, temporary rank, consequent on the retirement of Lieutenant-Colonel Ross, R.E., with effect from 2nd July 1888.

Mr. A. M. Fagan, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, permanent rank, consequent on the retirement of Lieutenant-Colonel Ross, R.E., with effect from 2nd July 1888.

Mr. A. M. Fagan, from Assistant Engineer, 1st grade, to Ex-

ecutive Engineer, 4th grade, temporary rank, *vice* Mr. Francken, granted furlough, with effect from 7th July 1888.

Mr. W. B. Gordon, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Mr. Mackenzie, granted furlough, with effect from 7th July 1888.

Mr. M. Nethersole, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Mr. Grant, granted furlough, with effect from 8th July 1888.

Mr. H. J. Strickland, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Mr. Beresford, promoted to Superintending Engineer, 3rd class, temporary rank, with effect from 25th July 1888.

This cancels Irrigation Branch Notification dated 26th July, 1888.

Mr. J. A. Cones, temporary Executive Engineer, 4th grade, Anupshahr Division, Ganges Canal, is appointed to the charge of the Anupshahr Division, Ganges Canal, during the absence of Mr. W. P. Richardson, Executive Engineer, on privilege leave, or until further orders.

Mahomed Elahi Baksh, Khan Sahib, Honorary Assistant Engineer, 1st grade, is transferred from the Agra Canal to the Betwa Canal Division.

Mr. C. G. Palmer, Executive Engineer, 2nd grade, on return from privilege leave, received charge of the Agra Canal Division from Mr. C. Hill, Executive Engineer, on the forenoon of the 4th September 1888.

#### Buildings and Roads Branch.

Mr. A. R. Sutherland, Assistant Engineer, 1st grade, is, on return from furlough, posted to the Moradabad District as District Engineer.

India, September 22, 1888.

His Excellency the Governor-General in Council having sanctioned a Survey to be undertaken of a line of Railway from Ranaghat to Gya, is pleased to place the same under the control of the Government of Bengal, and to appoint Mr. J. Ramsay, Superintending Engineer, 3rd class, sub. *pro tem.*, to be Engineer-in-Chief of the project. The project will be known as the Western Bengal Railway Survey.

Lieutenant J. E. Capper, R.E., Assistant Engineer, 1st grade, Central Provinces, is on return from furlough posted to Burma, Provincial Establishment. This cancels Public Works Notification dated 16th April, 1888.

Bengal, September 26, 1888.

Mr. J. S. L. Long, Assistant Engineer, passed the Lower Standard Examination in Hindustani on the 4th April 1887.

Mr. J. S. L. Long, Assistant Engineer, passed the Departmental Standard Examination in Hindustani on the 22nd October 1887.

The Lieutenant-Governor is pleased to make the following promotions in the Engineer Establishment with effect from the dates specified:—

Mr. G. L. Searight, from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, sub. *pro tem.*, with effect from 7th June 1888.

Rai Annoda Prosad Sarkar Sahib, from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, sub. *pro tem.*, with effect from 7th June 1888.

Rai Rakhal Dass Chatterjee Sahib, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 11th July 1888.

Rai Madhub Chunder Roy Bahadur, from Executive Engineer, 2nd grade, to Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 25th July 1888.

Mr. J. D. Davies, from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 25th July 1888.

Mr. W. P. Milne, from Executive Engineer, 4th grade, to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 25th July 1888.

Rai Prosono Coomar Duneary Sahib, from Executive Engineer, 4th grade (temporary rank), to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 25th July 1888.

#### Irrigation Branch.

Mr. W. A. Inglis, Executive Engineer, in charge of the Arrah Division, is granted privilege leave for three months, with effect from the 10th proximo, or such subsequent date as he may avail himself of it.

Mr. T. M. L. Thompson, Executive Engineer, Northern Drainage and Embankment Division, having returned to duty on the forenoon of the 15th instant, the unexpired portion of the three months' privilege leave granted to him is cancelled.



# Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Revenue and Agricultural Department :—

The 15th September 1888.

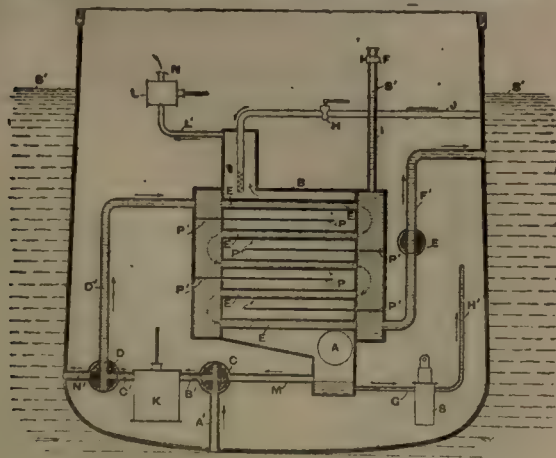
- 140 of '87.—William Dent Priestman and Samuel Priestman, Engineers, of Holderness Foundry, Hull, in the County of York, England.—For improvements in the construction and working of hydro-arburetted air Engines and in apparatus applicable thereto.
- 83 of '88.—Samuel Cleland Davidson of Belfast Ireland, Merchant.—For improvements in stoves or air-heating apparatus.
- 111 of '88.—Alfred Horatio Bell Sharpe of Lincoln, in the County of Lincoln, England, Engineer.—For improvements in tea drying machines.
- 122 of '88.—Joseph Carter Oakman of Sydney, in the Colony of New South Wales.—For an improved combined railway Buffer and automatic Coupling.
- 130 of '88.—William Berthold Ihne of Liverpool, England, Merchant.—For improvements in ladders.
- 134 of '88.—Percy Carlyle Gilchrist of Palace Chambers, Westminster, England, Metallurgist.—For improvements in the manufacture of iron and steel.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act V. of 1888, in the Office of the Secretary to the Government of India in the Revenue and Agricultural Department :—

- 4 of '88.—Conrad Herzog of London, England, Civil Engineer.—For improvements in apparatus for carburetting air and enriching gas.
- 23 of '88.—William Blizard Williamson and George Henry Williamson, trading as Williamson and Sons of Providence Works, in the City of Worcester, England, Manufacturers.—For improvements in metallic boxes or cases for storing articles of food, tobacco, snuff, and paint, and for other like purposes.
- 24 of '88.—William Blizard Williamson and George Henry Williamson, trading as Williamson and Sons of Providence Works, in the City of Worcester, England, Manufacturers.—For improvements in metallic boxes or cases for storing articles of food, tobacco, snuff, and paint, and for other like purposes.

## RECENT ENGLISH PATENTS.

CONDENSERS.—A. Burkhardt & F. J. Weiss, Basel, Switzerland.—The inventors here introduce an improved arrangement of a surface condenser and its pumps for use in connection with a marine engine. The accompanying figure illustrates an installation arranged according to the present invention. The exhaust steam enters the condenser B at A. The cold water pump K draws water from the outside through the pipes A' B', and forces it through C' D' into the upper part of the series of cooling pipes of the condenser. The plates P' cause the water to flow in the opposite direction to the steam. The water leaves the condenser near the bottom and returns to the outside again through F'. The pipe F is open at the top and serves to remove the air from the cooling pipes. The feed pump S draws the condensed steam through G and forces it through H' into the boilers together



with the sea water, which is allowed to enter the condenser through H J to make up for loss of water and steam. The dry vacuum pump L draws air through L' from the condenser, and forces it into the atmosphere at N. This arrangement may be adapted for use as an injection condenser by certain alterations. The sucking conduit of the cold water pump K must be connected with the lower part of the condenser and the forcing conduit with the outside by turning both the cocks C and D through a quarter revolution to the right; the cock H must be opened, and E and F closed. Injection water will be drawn into the condenser through the pipe J, and will flow down over the plates P, and will be drawn off through the pipes M B' by the pump K. The pumps L and S continue to work as before. Two claims are made for this combination of condenser and pumps, which may be employed on either the surface or injection condensation system. No. 18018. December 31st, 1887.

# ADVERTISEMENTS.

## NOTICE.

WANTED a District Engineer for the District Board of Chittagong, on a salary of Rs. 200, rising by Rs. 25 annual increment to Rs. 300 per month for approved work, with fixed daily allowance, Rs. 4 per diem, and mileage at the rates for a second class officer when out on duty. Candidates must possess qualification as prescribed by Government and published in the Calcutta Gazette of the 16th March 1887, IB, page 79.

Applications, with copies of testimonials and medical certificates of fitness for out-door duties, should be submitted to the undersigned before 30th November next, as prescribed in Rule 11 of the part quoted.

A. MANSON,  
CHAIRMAN,  
District Board.

CHITTAGONG, DISTRICT BOARD'S OFFICE }  
September 1888. }

## NOTICE.

TENDERS are invited for the erection of the following works at the Calcutta Medical College. Forms of the tender and all information connected with the works can be obtained at the office of the Superintendent of Works, Writers' Buildings.

NAMES OF WORKS.	Date on which tenders will be opened.
1. Police Dead House ...	5th October.
2. Servants' Quarters, Medical College ...	5th "
3. Latrines ...	5th "
4. Servants' Quarters; Eden Hospital ...	6th "
5. Kitchens and Godowns ...	6th "
6. Stables and Coach house ...	6th "
7. Cow Sheds ...	6th "
8. Laundry ...	6th "

G. F. E. S. NEILL,  
LIEUT.-COL., M.S.C.,  
Superintendent of Works,  
(194) Calcutta.

## WANTED.

THE Municipality of Sukkur; require an Engineer to supervise Drainage works costing Rs. 70,000

None without experience need apply.

The engagement will commence at once and will not exceed six months in duration.

J. G. SINGLE,  
M. INST. C. E.,  
Chairman, Drainage Committee,  
S. M. C.

SUKKUR; September 14th 1888.



**ROOMS WITH BOARD,**  
*BY DAY OR MONTH.*  
**Mrs. OGILVIE,**  
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 CORNER OF PARK STREET,  
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**A**N Engineer, 18 years' experience on Canal and Railway Construction—the last 6 of which he has been engaged on one of the largest Bridges in India—will be disengaged about the 15th September. Highest references and Testimonials.

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The Portable Engines and Pumps have all been in use, but they will be put into working order before being sent away.

The Agent and Chief Engineer, S. M. Railway, Dharwar, is prepared to receive offers for any of the above.

They are open to Inspection to any one wanting them.

Apply to AGENT and CHIEF ENGINEER.

(173)

S. M. Railway, Dharwar.

**CREAT WESTERN HOTEL,**  
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NOW READY.

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**B**Y the undersigned. Has worked on the State Railway Surveys and on the Permanent Way. Holds an Overseer's Certificate from the Madras Engineering College and has Testimonials

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No. 10 Kolanda Street, Park Town, Madras.

(185)

## P. W. D. CHITTAGONG DIVISION.

Tenders are invited for supply of doors and windows noted below. The Executive Engineer does not bind himself to accept the lowest or any tender.

NAME OF WORK.	Tender to be in Form No.	Amount of earnest money to accompany each tender.	Date and hour of opening tenders.	Date of commencement of work.	Date of completion of work.	Deposit money required to be paid by the successful tenders.	REMARKS.
Supplying Doors and Windows for the new Courts on Fairy Hill, Chittagong.	P. W. D. Form No. 14 M.	Five rates printed on the back of the form quoted above.	12 o'clock Saturday 6th October 1888.	On receipt of acceptance of Tender.	15th February 1889.	Rs. 10 per cent on the Total value.	Three sheets of plans and specifications can be seen— At the office of the Executive Engineer, 1st Calcutta Division; At the office of the Executive Engineer, Dacca Division; At the Head office of the Chittagong Division (Chittagong); Special attention is drawn to Clause VI of the specification.

F. SILLS, C.E.,  
 EXECUTIVE ENGINEER,  
 Chittagong Division.

(189)

CHITTAGONG;  
 The 10th September 1888.



(108)



## BURRAKUR IRON WORKS, BURRAKUR, BENGAL.

Cast-iron Socket Pipes, of ordinary dimensions, coated with Dr. Angus Smith's solution, and tested up to a pressure of 250 feet of water	Rs. 4-4 per cwt.
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Cast-iron Bends, Tees and Cross Pieces for Pipings of ordinary dimensions coated with Dr. Angus Smith's solution from	" 7-0 " upwards.
Cast-iron Fire-bars, Floor-plates, Plain Columns, &c., from	" 5-0 " "
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Cast-iron Ornamental Columns, railings, gates, spiral staircases, porticos, brackets, arch-fillings, &c., in great variety	At cheapest rates.
Cast-iron Rammers, Road Rollers Garden Rollers, Sugarcane Rollers, Rain-water Pipes, Axle-boxes, parts of machinery and other castings of any description	At cheapest rates.
Water-lifts ... from Rs. 35-0 each, and upwards.	Foundry Pig Iron No. 1 ... " 45-0 per ton.
Ploughs ... Rs. 4-0 each.	Ditto No. 2 ... " 42-8 "
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Remarks.—Special quotations for large orders. Designs of Ornamental Castings of any description can be had on application.  
Orders to be addressed to the SUPERINTENDENT from whom any further particulars can be ascertained.

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(168)

**Telegraphic Address—"SILVERGRAY," CALCUTTA.**

## COMMERCIAL UNION ASSURANCE CO., LD.

*Extracts from the Twenty-sixth Annual Report viz. for the year 1887.*

FIRE DEPARTMENT.		LIFE DEPARTMENT.		MARINE DEPARTMENT.	
Premiums after deducting		Premiums after deducting		Premiums after deducting	
Re-insurances	£ 769,265 0 0	Re-insurances	£ 125,559 0 0	Re-insurances	£ 175,118 0 0
Interest	£ 19,612 0 0	Interest and Dividends	£ 45,649 0 0	Interest	£ 8,294 0 0
Losses after deducting Re-insurances	£ 443,587 0 0	Claims less Re-insurances,	£ 79,229 0 0	Losses after deducting Re-insurances	£ 138,365 0 0
				Interest not belonging to above, but included in Profit and Loss	£ 18,545 0 0

The Life Fund was increased during the year by £65,648 and now amounts to £1,070,064.

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the uncalled Capital of £2,250,000.

The rates of Premium are moderate, but they are not unsafely low, and will be found to stand the test of time, thereby in conjunction with the ample Funds affording absolute security to the assured.

The Total Funds and property in hand on 31st December 1887 stood at £2,613,059.

(39)

**C. H. OGBOURNE, Manager and Underwriter.**

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Numerous favourable certificates of the quality of our manufacture have been received, and the following are fair selections:—

J. H. APJOHN, Esq., Superintending Engineer, Kidderpore Dock Works, says:—

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PAUL DEJOUX, Esq., Executive Engineer, Government Cement Experiment Division, reported:—

"It is the best Ghooting Lime imported into Calcutta."

JAMES KIMBER, Esq., M.I.O.E., Engineer to the Corporation of Calcutta, says:—

"It has been for long past and is now invariably used in all works, particularly drainage works. I have much pleasure in certifying to the excellent and reliable quality of the Lime."

O. A. MILLS, Esq., Executive Engineer, P. W. D., 2nd Calcutta Division, says:—

The Ghooting Lime manufactured by Messrs. Burn & Co. is better than any that can be purchased in Calcutta. I have used it in the construction of many public buildings and have been thoroughly satisfied with it."

N.B.—Our Lime was used throughout all the River Works of the Calcutta Port Commissioners.

## BURN & CO.,

(179)

7, Hastings Street, or Raneegunge.



## Notices.

The Office of Publication of Indian Engineering is at the "STAR PRESS," 19, Lall Bazar, Calcutta.

General correspondence, and all communications bearing upon literary matters, should, as heretofore, be addressed to PAT. DOYLE, C.E., Spence's Hotel, Calcutta.

It is particularly requested that all letters on business concerning subscriptions and advertisements be addressed to the "Managing Agents," MESSRS. BALMER, LAWRIE & CO., 103, Clive Street, Calcutta; and all remittances be made payable to them.

### Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	Rs. 12	Rs. 7	Rs. 4
Specimen copy—Free; Single copy—One Rupee.			

Foreign Subscriptions should be converted at current exchange and postage added.

### FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—D. J. KEYMER & Co., Whitefriar's Street.

NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, Park Place.

ROME.—LOESCHER & Co.

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One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
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Double these rates for outside front.

An allowance is made for continuous insertions.

### NOW READY.

## "Artesian Borings in the Sunderbunds."

As the issues of the journal containing the articles headed as above are out of print, and sufficient inducement having offered, the matter has been reproduced in pamphlet form to meet the requirements of District Officers and others in Bengal and elsewhere.

Price Rs. 2 per copy.—Cash.

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## Obituary.

DIBBLEE.—At Calcutta, F. L. Dibblee, M.I.C.E., Executive Engineer, P. W. D., aged 51 years.

# INDIAN ENGINEERING.

SATURDAY, OCTOBER 6, 1888.

### RAILWAYS AND RED TAPE.

"I certify that the expenditure charged in this bill could not, with due regard to the interests of the public service, be avoided. I have satisfied myself that the charges entered in this bill have been really paid. Vouchers for all charges for service postage labels and State telegrams, and for all other charges above Rupees 10 in amount, are attached to the bill. I have, as far as possible, obtained vouchers for other sums less than Rupees 10, and am personally responsible that they have been so defaced that they cannot be used again."

For the benefit of those readers who are not acquainted with the elegant form of certificate given above, we may explain that it is the certificate attached to the foot of the Contingent Bill on some at least of the State Railways.

Nor is this all. One would suppose that such a comprehensive form of certificate would in itself be enough, but the demon of red tape is not to be appeased by mere verbosity however exuberant, he must have routine as well. Consequently the contingent bills of all officers are collected by the heads of departments, countersigned by them, and sent together with their own, to be again countersigned by the Manager of the Railway, and so to the Examiner of Accounts. We believe that even the Director of the N. W. S. Railway, an official drawing Rs. 2,500 per mensem, is supposed to spend part of his time countersigning those precious documents.

And all this for a trifling expenditure, which, as it almost entirely consists of payments for service postage labels and State telegrams, is purely nominal and goes back into the pockets of Government.

This is a matter trifling in itself, but which well illustrates the utter want of commonsense which characterises the management of Government departments in general, and is most pernicious in those, which like State Railways, are supposed to be conducted on "commercial principles."

Observe firstly the inutility of the form itself. Why certify that the charges have been "really paid" when the vouchers have to be attached? Why certify that vouchers are attached when it is a matter of fact, and not of trust, that they are? Why certify that they have been defaced, when that is again a self-evident proposition.

Supposing even that there were nothing ridiculous in the mere form of words, it surely might occur to an Examiner of Accounts, that the whole idea is absurd. The more elaborate the certificate, and the greater the number of signatures with which the document is be-plastered, the less the attention paid to them; the less in fact can be paid on account of the waste of time in multiplying unnecessary documents and signatures.

Fancy the Manager of a State Railway having nothing



better to do, than to countersign the contingent bills of all officers on the line.

We have read somewhere of a man who laid a bet and won it, that he would get an official to sign a copy of the Lord's Prayer. The document was duly written out, giving it an official aspect, and having been introduced into a pile of papers for signature, passed without question.

It would be incredible, were it not instanced every day, how the gnat is strained at, with the inevitable result of swallowing the camel. Here is a most elaborate conscience trap, so elaborate as to miss its effect, which, involving a purely book expenditure of a very few rupees, is first signed by an officer who has the power of wasting thousands without possible detection. This is not enough, it must go to a higher, who can really certify to nothing, his signature is purely formal and worthless. If he signs it himself, he is wasting time which would be much better employed. If it is signed by an irresponsible assistant, it is meaningless; for the assistant will generally be of a lower grade than the original signatory, and may be in some cases simply a native assistant kept in that post because he cannot be utilised in any other. And after all this signing, it goes to the department whose sole duty it is to examine such documents, and to whom it might just as well have gone in the first instance.

The Government of India try cheeseparing on the salaries of unfortunate subordinates because the cost of management is excessive. Let them try the effect of a little commonsense and reduce their clerical establishments by one half, giving up useless forms and procedures and the compilation of tons of returns which are never used, and which, when required, would be found unreliable from the lack of sense with which they are compiled. Figures thrown together anyhow, without a mind to direct and assist them, do not constitute statistics; nor do documents of the nature of our sample, make account keeping, or constitute any check whatever.

The present Director-General of Railways is credited with being an officer of broad views, and he certainly has the advantage of an exceptional experience both on the executive and financial side of the question. Let us hope he will direct some of his energy towards pruning, not the salaries of subordinates, but the extravagances of the department in the mania for returns and signatures.

#### THE MADRAS CANALS.

It is possible to be severely practical, when reviewing such ineptitudes in print as the Irrigational Review for last year, lately put forth by the Madras Public Works Department. It has the decency to admit, without palliation, that canal traffic on the Madras canals, continues to be unremunerative. So it always will be, probably, until English rulers of India learn a lesson from Akbar and Aurungzeb, and furnish canals in such parts of the country, wherein need for them is apparent; not in such parts of the country as idle native newspaper clamour is omnipotent in—*e.g.*, Kurnool and Caddapah.

It is a pity, from a statistical point of view, that the Madras Secretariat feels itself unable, finds it impossible to determine with accuracy, the cost of canal maintenance, and of irrigation, in the Southern Presidency. This is an unfortuitous disposition of red-tape, prejudicial equally to the Secretariat and the public. The Chief Engineer for Irrigation suggests that the charges are made up of the following items:—

- (1) Lock establishments.
- (2) Lock and weir repairs.
- (3) Navigation buildings.
- (4) Tow-path maintenance.
- (5) Dredging.
- (6) Miscellaneous.
- (7) Share of canal maintenance.
- (8) Miscellaneous general charges.
- (9) Interest on capital.

Some of these, authority is pleased to call "direct charges": for others it would seem to have no very specific nomenclature. The whole ordering of affairs seems to us in short very devoid of order, ill-considered, if at all considered, tending to complexities and perplexities rather than judicious combination and harmonizing of ways and means. Here is a parable—paragraph 5 of the Chief Engineer's "Note:—"

"In the Godavari, about 25 per cent. of the canal repairs and miscellaneous charges are debited to navigation. If these charges to the Kistna navigation were calculated as those in the Godavari, they would amount to Rs. 20,300 in place of Rs. 41,236, reducing the total charges from Rs. 91,406 to Rs. 70,460." If the clerks in the Chief Engineer's Office don't know how to keep accounts, and if the Chief Engineer finds himself unable to instruct them as to the proper method of fulfilling their duties, it seems to us that he would act more wisely, at any rate in his own interests, in maintaining a judicious silent reserve on the subject rather than in proclaiming it from house-tops to all the world and his wife.

The Buckingham Canal is acknowledged to be "an incomplete work." We have never heard of any public undertaking affiliated in any sort to the vainglorious, incompetent, double-barrelled Duke—of Buckingham and Chandos—that was not incomplete and inefficient. Madras is fain to appeal for subsidies to the Government of India for this inchoate gubernatorial fad. We are fain to hope that all such untimely unwarranted missives may be relegated to the limbo of forgetfulness provided in all public offices, in pigeon-pole arrangements, for such trash.

In paragraph 13 of the Report before us, it is written that the charges on the upkeep of the Buckingham Canal are very heavy. Why then continue to maintain it? 'Tis of infinitesimally little use, if of any use at all, to the tax-paying public. If, that is to say, it has any foundation, any bottom, any dependence on anything more secure than *effête* officialdom.

Colonel Mead has ideas about cyclones, and writes there anent, with reference to this canal:—

"If the canal were completed, it would not be so



seriously damaged as now, by cyclones, and the cost of maintenance would be much reduced. In paragraph 20 of the Chief Engineer's Note, printed in G. O. No. 562 W., dated 20th February 1883, the maintenance, when the canal is completed, is estimated at Rs. 45,000. I doubt this being sufficient, as the river crossings on the canal will be always expensive to maintain; I would, therefore, prefer to estimate this at Rs. 75,000 per year. This amount is not much more than the present receipts from canals, and these receipts are increasing yearly. If the canal was completed and in good order, the receipts would, I consider, more than cover the charges."

"I consider" is good, fortuitous, pretty; but it won't hold water from a business point of view. "If's" are irreparable damages to such point of view, uncertainties are unbusiness-like, however much they may be bolstered up with dead-weight of consideration; possibilities can by no manner of means be made equal in value to certainties. Attempt to make out non-paying, utterly unremunerative canals as wealth originators to the State, is a folly with which we are not exactly determined as to whether we ought to be angry or amused.

#### BOMBAY MILL INDUSTRY.

THE Bombay Millowners' Association has been asserting itself, and doing useful work, by publication of carefully compiled statistics, having reference to and bearing on the mill industry, the mill producing power, of the Western Presidency. Its figured returns set forth a notable development of production power; a vast improvement on old, traditional manufacturing courses, and usages.

At the end of June—our Report deals with no later facts—there were fifty-two mills in full working order in Bombay, and eight more in full course of erection.

That is not an insignificant total on progressive roads; but yet it by no means adequately represents the rapidity with which mill industries are growing into life, and gaining a hold on popular favor in Bombay. There are, at the present moment, fifteen more mills, either projected, or in course of construction. The more the merrier. *Laudantur*. It is confidently asserted by the Bombay press that, a few years hence, more than half the cotton mills in India will be on the island of Bombay. It is a result that may come to pass; a prophecy that may of course be verified by the logic of events.

But, in taking the issues on such a question, innate Bombay bumptiousness ought to be duly weighed in the scale, and subtracted from nett weight returns, as per scale. It is not wise to place over much dependence on the high falutin statements of the most respectable and eligible on Change people, when they have contracted an inveterate habit of what Americans call—gasing. Tide of public opinion in Bombay seems to have converged hopelessly in that direction; to be getting more aimlessly self-conceited and inefficient for control every year.

Calcutta is blameworthy in that she does not assert

herself as she might, as she ought to, in this matter. There are many mills on this eastern side of India, more we believe than on the western side; but they work unpretentiously and do good for millions without the bombast that seems essential to the maintenance of similar business concerns on the Bombay side.

For many very obvious reasons *gas* ought to be avoided at all times; especially should it be avoided when men are putting forth their best, their honest endeavours to fundamentalize and lay corner stones for the building up of a new enterprize, a new industry. The *Bombay Gazette* has at any rate the courage of Bombay opinions; does not scruple to declare specifically that easternwards geographically disposed markets have faculties for the absorption of a certain residue of Lancashire and Bombay products. But to what extent? Will the percentage pay? That is the crucial question at this fag end of the nineteenth century. Can Bombay ever hope to supplant Calcutta as the capital of India? We think not. In its open sea frontage, in its greater nearness to Overland Mails, in its approximations to Europeanism, Bombay has made as big bids as it is in her power to offer for capitalship in India. Unavailingly. Calcutta remains the recognized head centre of Government; will so continue till Simla is foisted on the public as a substitute. Bombay has no remotest chance, here, there, or anywhere. Bombay had better stick to its mills. They have pretty nearly driven the Lancashire Mills into bankruptcy: it is their manifest destiny to extinguish them. For, the course of production is now-a-days being carried forward by leaps and bounds, not by such slow processes as found favor with antediluvians, or *quasi* antediluvians, concerning themselves with the world's markets for the time being, in times long ago and forgotten.

The *Bombay Gazette* is careful to stipulate that the mill industry is not being "overdone" in the Western Presidency. Who could ever suppose that it was? Far more reasonable supposition would it be that it is being underdone. But, Bombay fashions and habitudes are bound to be peculiar; and are not worth much serious attention. Japan is the only rival Bombay seems to fear seriously. About this rivalry it is written in a late issue of the *Bombay Gazette*:—Japan has taken to building mills lately on a large scale, and with its clever and progressive population it will not depend upon India or England for its yarn any more than it can help. It may be necessary, therefore, to moderate our expectations in that direction. A letter received by a Bombay millowner from his agent in Kobe subsequently, gives some interesting information on this subject. "The natives inform us," he says, "that when all the spinning mills now in course of promotion in this district are at work, the production will amount to two hundred bales of yarn a day."

The time is not so very far off when the ghost of Mr. Wilberforce will once more be found in possession of a seat in Parliament, and in opposition to "mill-dom" of any description whatsoever.



## Notes and Comments.

**INDIAN MIDLAND RAILWAY.**—The Jhansi-Lalitpur section of the Indian Midland Railway is almost completed, and it is hoped that it will be opened for traffic early in January.

**THE FUTURE IRONWORKS AT BURRAKUR.**—We learn that the Government of Bengal have received a definite offer for the Burrakur Ironworks from the Home Syndicate and that this concern is likely to change hands in consequence.

**THE MINING SCANDAL.**—The *Bombay Gazette* says that the only safe and reasonable course under present circumstances is for the Nizam to obtain the best legal advice procurable, and having obtained it to act upon it and abide by the result.

**MYSORE P. W. D.**—The Superintending Engineer, Mysore P. W. Department, Bangalore, is calling for tenders for constructing bridges across the Tunga at Hariharpur District and across the Budra at Balchonnur, both in the Koppa Taluk of the Kadur District.

**THE LARGEST LOCOMOTIVE STATION IN THE EAST.**—Asansol, the largest "running" station on the East Indian Railway, is said to be the largest of its kind in India, and, perhaps, in the world, for we might reasonably question whether another "loco." station could be found anywhere with a record of 120 working engines.

**THE TRANS-CASPIAN RAILWAY PORT TERMINUS.**—The Russian Government has always had a difficulty in finding a suitable port on the eastern shore of the Caspian as a terminus for the Railway which was lately completed to Bokhara and Samarkand. It has been finally decided that the terminus and port are to be transferred to Krasnovodsk from Ouzaun-Ada.

**CEMENT WORKS IN BENGAL.**—We are sorry to learn that the project for the resuscitation of the Raniganj Cement Works has been somewhat retarded or obstructed by the counter-proposal to erect Cement Works at Burakur, where it is contended that greater facilities are available for such manufacture; but with this contention we are not disposed to agree.

**EASTERN BENGAL STATE RAILWAY.**—A correspondent of a contemporary writes:—Great inconvenience is felt by the passengers of the Eastern Bengal State Railway line owing to the intermediate and third-class carriages being not sufficiently provided with lights in the night trains. The matter has repeatedly been brought to the notice of the Railway authorities, but without effect.

**THE INDIGO OUTTURN.**—Detailed estimates of the indigo manufacture for this season shew a probable crop of 130,000 maunds, against an actual crop of 130,825 maunds last year. Bengal contributes 22,500 maunds, Behar 69,700 maunds, Benares 12,000 maunds, and the Doab 25,800 maunds. The chief increase has been in Behar, but the figures may yet be considerably modified.

**FORESTRY AT COOPER'S HILL.**—We understand that the Government of India has recommended to the Home Government that the course of study for forest students, intended for the Indian Service, at the Royal Engineering College at Cooper's Hill, should be extended to three years, and that the pay of the men on appointment to India should be increased from Rs. 250 to Rs. 350 per mensem.

**PETROLEUM PROJECTS IN BILUCHISTAN.**—A Report lately laid before Government by Mr. R. A. Townsend,

the Canadian expert who superintends the Petroleum Works in Biluchistan, takes such a rosy view of the wealth and extent of the petroleum springs above referred to that, were he not known to be a responsible and practical man, there would be an excuse for doubting his conclusions.

**THE COMFORT AND CONVENIENCE OF RAILWAY PASSENGERS.**—We learn that the authorities of the E. I. R. have been induced to enhance the rates for refreshments where such are obtainable on their line. It would, we consider, have been a wise and an equitable proceeding to allow sufficient waiting time to enable passengers doing justice to the not very tempting or over liberal bill of fare provided at the caterers' "rooms."

**THE LUCKNOW BORING.**—It may not be generally known that the boring apparatus employed for sinking the artesian well at Lucknow is only a larger class of that so successfully used at Alipore and recently referred to by us. The operations at Lucknow appear to us to be enshrouded in mystery and a little more light on the subject is desirable for many reasons—not the least of which is the rumour that a screw has got loose and disarranged the working gear.

**RAILWAY BRAKES.**—One of our correspondents in Bombay writes:—There is much confusion prevalent because of the stupid resemblance in the titles of two or three different systems of brakes. The B. B. and C. I. Railway has had the Vacuum Brake Co.'s brake in use on every passenger train for six or eight years. The G. I. P. Railway has a "Vacuum" brake on some local trains and an "Atmospheric" on others. Both are distinct from the first, and all are distinct from the "Westinghouse."

**THREATENED COAL FAMINE IN THE AUSTRALIAN COLONIES.**—News received from Newcastle, N. S. W., states that the excitement there in connection with the threatened strike is very great. There are forty-nine vessels now lying in port waiting for coal, exclusive of coasters, the aggregate tonnage being over 58,000 tons. During the next two or three months 100 vessels are expected, irrespective of inter-colonial vessels, and there was every prospect of a busy season if the strike had been averted.

**THE ACCOUNTS BRANCH, P. W. D.**—A small Committee is sitting at Simla to arrange the conditions for admission into the Upper Subordinate ranks of the Accounts Branch of the Public Works Department. It is proposed that this shall be by nomination tempered by competitive examination. The examination suggested is, we believe, a very stiff one, and the scheme is, on the face of it, open to one grave objection at least, that it will be costly. To get good Examiners you must pay well, and we doubt whether fees could be levied to cover the cost of conducting the Examination as proposed.

**THE PROPOSED DAMUDA BRIDGE—B. N. R.**—A correspondent writes:—"A lot of unnecessary noise is being made over the bridge intended to be erected over the Damuda on the Bengal-Nagpur Railway. A bridge of greater length was erected by the P. W. D. in the same neighbourhood over the Burrakur under like or greater difficulties on the Grand Trunk Road, while the E. I. R. are quietly preparing to bridge the latter river in their proposed branch extension to the coalfields beyond." We may add that the design for this structure provides for the erection of the piers on double 8ft. diameter iron girders.



**INDIAN ORDERS FOR RAILWAY WORKS.**—Some activity is announced at the Staffordshire Iron and Steel Engineers Works in filling orders arrived from India. Constructive Engineers are busy on Indian bridge work. The Railway wagon manufacturing companies have valuable Indian contracts in hand, and the steel-masters are executing important orders for plates and channels for India. The Staffordshire Steel and Ingot Iron Company have under execution a contract for 2,500 tons of steel bridge plates for the Bengal and Nagpur Railway. This Company is at present fully engaged, and other large export orders are anticipated.

**THE DELHI-KALKA RAILWAY.**—The Honorable Mr. Steel of Calcutta, one of the projectors of the Delhi-Kalka Railway scheme, denies the statement that it is likely to collapse on account of financial difficulties. The report, however, was so generally credited in Simla, even in the best-informed official circles, that the alternative proposal of a State line was again freely discussed. Mr. Steel says that the Company which is being formed will be brought out simultaneously both in London and Calcutta next month; that half the required capital has been promised, and that the whole will be guaranteed by financial houses at home.

**BANGANAPALLE STATE PUBLIC WORKS.**—In the Administration Report of the small State of Banganapalle in the Kurnool District for 1887-88, we find that a sum of Rs. 11,350 was spent on public works against Rs. 11,850 in the preceding year. The expenditure was incurred on the following works:—Repair of irrigation works and the improvement thereof, Rs. 550; construction of new road from Banganapalle to Bellary-Kistna State Railway station at Panem, Rs. 8,100; repairs of Rampoor pass road and roads in Banganapalle, Rs. 2,000; repairs of State bungalow and cutcherry, Rs. 700; total Rs. 11,350. The collection of road-cess was Rs. 9,225, and the amount spent by the Nawab for the upkeep of the roads Rs. 11,350.

**THE ASSAM-CHITTAGONG RAILWAY.**—Sir Theodore Hope, our late Public Works Minister, has become a promoter of Railways, as is natural he should do, commencing, we understand, with a proposal now before the Government of India for a line from Chittagong to Dibrugarh. The line would be about 600 miles long and its cost about six millions sterling. The projectors require a concession of five miles of land on either side of their track, wherever available, and certain rights in connection with the coal and petroleum resources of the country to be opened out. The *Pioneer* does not consider it probable that the scheme will find favor immediately; but the large area of tea lands to be traversed, and the necessity of providing an outlet for the coal and oil of the Upper Assam Valley, clearly mark the project as one worthy of consideration.

**RIVER CHANGES IN BENGAL.**—A correspondent writes:—As an incident of the study of river changes in Bengal, I am mooting a scheme for the reversion of the Damuda into its old bed near Kalna. You know the terrible damage to people and lakhs of Revenue losses to Government and thousands of lives lost by the bursting of the Damuda embankments, and the terrible James and Mary sands at its mouth. I say these evils would be all got rid of by the retrocession of the Damuda to its former bed. AND, in addition to the wiping away of these evils, would be the powerful help given to the deepening of the Hooghly bed below Calcutta, by the pouring in of the

great body of the Damuda waters into it at such a safe distance (50 miles) above Calcutta, that even were a fresh "James and Mary" to be deposited *there*, it could not possibly injure the ocean trade of Calcutta.

**A BRIEF HISTORICAL SKETCH OF THE MADRAS HARBOUR WORKS.**—The Madras Harbour scheme was set on foot by Lord Hobart, Governor of Madras, in 1873, in which year Mr. William Parkes submitted his plan, with an estimate amounting to Rs. 56,45,000; in March 1875 the undertaking was sanctioned by the Secretary of State; and in December of the same year a memorial stone was laid by the Prince of Wales. In January 1876 work was begun in earnest. In October 1881 the original design was all but completed, and an area of 210 acres was enclosed by piers constructed of concrete blocks. Then came the second class cyclone of November 1881, and the two piers, which had occupied six years in construction, were destroyed from the curves of each arm outwards, and the space that they enclosed was again exposed to the sea. The Government was induced to sanction a second estimate amounting to 45 lakhs, for the restoration of the Harbour, and up to date about 90 lakhs have been spent on the work, but the greater part of the eastern arm has yet to be built. At a rough calculation 25 lakhs will be needed, according to the revised design, to complete the work, in which case the Harbour will represent—irrespective of interest—an outlay of 115 lakhs.

**RAILWAY ECONOMICS.**—Mr. Horace Bell has been devoting some small portion of his leisure at home to the advocacy of a reduction of third-class fares on the English Railways. Thus he writes to the *Times*:—As a contribution to your correspondence on the reduction of third-class Railway fares, I would suggest to our Railway managers at home to see at what very low rates it is found profitable to carry third-class passengers on our Indian Railways, and how immediate and beneficial to both the Railways and the country have been the results of liberal reductions. On most of our Indian Railways the lowest or third-class fare is, at present exchange, less than a farthing a mile, and this traffic affords the most considerable and profitable source of their income. I do not say that it is possible to come down to so low a figure on English Railways, but I can see no reason why a very considerable reduction in our third-class fares should not yield as good results as on our Indian Railways. I feel, at any rate, convinced that if our Railway managers would, instead of racing small loads of passengers between our principal towns, devote themselves to carrying large numbers at lower rates and moderate speeds, they would realize surprisingly better results than they now get out of their passenger traffic.

**CHANGES IN THE MADRAS P. W. D.**—Colonel J. O. Hasted, R.E., as already announced, goes home on six months' leave and practically ends his Indian career then. The choice of his successor naturally laid between two officers of, curiously enough, exactly the same length of service, Colonel H. R. Mead, who held the appointment of Chief Engineer and Joint Secretary to Government Irrigation Branch, and Colonel C. J. Smith, who is at present Consulting Engineer and Joint Secretary to Government, P. W. D., Railway Branch. It has been decided Colonel Mead will succeed Colonel Hasted, and will retire next year, thus leaving the appointment open then for Colonel Smith. The vacancy caused by Colonel Mead's promotion will be filled by Mr. G. T. Walch, M.I.C.E.



(who is *not* one of the "Stanley Engineers" as a contemporary observes). The appointment would, no doubt, have gone to Mr. J. W. Rundall, but that officer's plans have been influenced by the death of his brother, and he retires from the service at once. Colonel Pennycuik, R.E., was, we believe, sounded as to his willingness to become Chief Engineer for Irrigation, but is unwilling to desert the splendid project for the alteration of the course of the Periyar, on which he is engaged, and in association with which he may reasonably expect that his name will be handed down to posterity.

THE LATE MR. F. L. DIBBLEE, M. INST. C.E.—A correspondent writes:—It is with much regret that I allude to the sudden death of Mr. F. L. Dibblee, at the Bengal Club, on the 28th of September. He was well known in Madras and the Punjab, where he had for many years filled high positions in various Railways. After practicing abroad, in Brazil and elsewhere, he came out to India as Chief Engineer for a Railway Company in Madras. He afterwards joined the P. W. Department; and was for some years on the Indus Valley Railway; then as Engineer-in-Chief, Delhi-Ferozepore Railway Survey, the Western Deccan Railway Survey and the Cuddapah-Nellore State Railway near Madras. He was an Engineer of ability and high professional attainments, and an able writer—though, no doubt, at times, his pen flowed too fluently for his own good. Those who knew him well, found, under a somewhat cynical manner, a kind and generous mind, and a clever and entertaining companion. He was on his way to join the Delhi-Kotri Survey, having come from the Toungoo-Mandalay Railway, in which climate he, without doubt, contracted the fever which led to his death here. Civil Engineers are certainly given many opportunities of encountering dangers and difficulties in distant tracts without the hope of reward or honor. The result is often only a man less, one widow more, a few fatherless children, and no pension to pay.

THE DISCOURAGEMENT OF INDIAN ENTERPRISE.—The Government of India have, as we have over and over pointed out, emphasized the importance of encouraging Indian manufactures. Their instructions are issued in the shape of neatly worded Resolutions, drafted in the Financial Department, and published, of course, in the name of His Excellency the Viceroy. The burthen of these Resolutions is that when articles of Indian manufacture suitable for use can be obtained in India, preference should be given to them, provided the cost does not exceed that which would be entailed by importing the articles from Europe. But the principle enunciated, while it is intended to give encouragement to Indian enterprise and trade, is very often forgotten by the authorities who frame the rules. The latest example in this direction has been adduced in the furnishing of the Viceregal Lodge at Simla. Our Bombay contemporaries have strongly denounced the action of Government in ordering out the furniture all the way from London. The cost of the English furniture supplied by Messrs. Maple and Son alone will, including cost of transit, &c., come to two lakhs of rupees. We need not say that this is most unfair to Indian manufacturers. Madras, Bombay and Calcutta, not to speak of other important cities, have manufactories where the most exquisite articles are turned out, and yet we have two hundred thousand rupees of the public money diverted into the pockets of manufacturers ten thousand miles away! And yet reductions are the order of the day!

## Current News.

THE Railway Conference will conclude its sittings at the close of the current week.

FINAL orders, sanctioning the construction of a tramway at Jubbulpore, have been issued.

MR. SWANN, C.I.E., of the Irrawaddy Flotilla Co., is expected shortly from home; as is also Mr. Rigg of the Burma State Railway.

A DISCOVERY of coal has been made on a Government estate in the Julpigoorie District, and the Geological Survey Department will report on it.

A REDUCTION in the office establishment of the E. I. Railway Engineering Department has been proposed to be enforced from an early date this month.

LIEUTENANT-COLONEL J. WATERHOUSE, of the Survey of India Department, has written an interesting paper on the phenomena known in Bengal as the "Barisal Guns."

SEVERAL members of the Railway Conference will, on the conclusion of their labours, leave Simla for Quetta, to test some carriages over the gradient portion of the line.

THE Government of India has sanctioned a special scale of allowances for Officers and Subordinates of the Survey of India Department, when employed with an army in the field.

MR. TOWNSEND, who has been managing the Petroleum Operations in Biluchistan, is to be employed for some time in Assam in exploring mineral oil deposits in that part of the country.

THE floods have so greatly abated that work on the new Pegu Town Bridge will shortly be resumed. The engineer-in-charge, expects to have the whole thing ready for traffic by March.

INTIMATION has been received by the Public Works Department of the Government of India that one of the Bombay-Aden cables has been repaired and through communication *via* Suez restored.

THE rainfall in Hyderabad, Deccan, has been very scanty up to date, and the water-supply, both in tanks and wells is very low. Great fears are entertained by the Nizam's Government of scarcity, if not of famine.

COMMUNICATION by telegraph between Calcutta and False Point, which has been interrupted since the last cyclone, has now been restored. The damage done at the point is considerable, but there was no loss of life.

No hopes of the Toungoo-Mandalay line being opened early. The train has been running up from Toungoo to Pynamana, and from Mandalay to Kyaukse; but when the gap will be run over it is impossible to say exactly.

A COMMITTEE at the India Office is overhauling the subject of home charges. It consists of Mr. Godley, Permanent-Under-Secretary, as president, and Sir John Strachey, Sir Alfred Lyall, Mr. Currie, and Mr. Robert Hardie as members.

COLONEL MALLOCK, Director-General of Telegraphs, proceeds this month on three months' tour in Persia to inspect the Indo-European line, which is now in the hands of the Government of India. Mr. Brooke will carry on the work of Director-General.

OFFICIAL denial is given to the reports of widespread distress in the Burdwan and Midnapore districts. Necessity exists for relief in some places, and it has been promptly afforded; but nothing is anticipated with which the local authorities may not easily deal.

A WAR on the Irrawaddy Flotilla Company, by the Rangoon public, set in some time ago, and still continues. The point in dispute seems to be, whether the Company has been a success or not—a hostile paper arguing that it has been, and a friendly one that it has not.

THE result of the inquiries made regarding the paper manufactured at the Reay Mills at Poona is very satisfactory. Many sorts chiefly printing and packing papers, of the estimated yearly value of Rs. 1,79,815, hitherto obtained from England, can now, it is found, be supplied by those mills.

THE Simla Municipality has applied to the Government of India for a further loan of Rs. 25,000 for the purpose of completing the Town Hall; and it is intended to incorporate this loan with the former one of Rs. 1,75,000, and to form one scheme for the repayment of the whole sum of Rs. 2,00,000.

THE Public Works Secretariat of the Government of India has just issued a set of revised rules for regulating the rents to be charged for Government buildings occupied as residences by Government officials, as well as regarding the construction or purchase of residences for Government officials.



THE Madras Government sanctioned the grant of Canal water for dry lands at half the prescribed water-rate in the Kurnool District. The dry crop area in the District commanded by the Canal is about 150,000 acres, and the ryots, in expectation of rain, preferred not to utilise Canal water lest they should be charged with the full water-rate.

It appears that the announcement that the Government of India had negatived the proposal for a special mail service between Calcutta and Bombay was not quite correct, and that there is a fair prospect of the project being carried out if the postal authorities will only agree to certain terms which, presumably, have been proposed by the Railway authorities.

A KURRACHEE paper hears that Mr. F. G. Mathew, C.I.E., Traffic Superintendent of the Punjab section of the North-Western Railway, is to be appointed a traffic expert in the office of the Director-General of Railways in India on the amalgamation scheme being settled, and that Mr. Chamberlain, the Traffic Superintendent of the Sind section, was to have reported himself at Lahore on the 1st instant.

## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

### RAILWAY BRAKES.

SIR,—Some time ago I noticed a statement in your paper to the effect that continuous brakes were not in use in India. It may interest you to know that the B. B. and C. I. Co. are using vacuum brakes on all their local trains, and I believe on their mail trains also, and have done so, I understand, for a considerable time.

October 1, 1888.

M. I. M. E.

### INFORMATION WANTED.

SIR,—I shall feel obliged if you, or any of your readers, will kindly inform me of a remedy for the destruction caused to certain kinds of timber by carpenter bees. I find the joists and beams of a rest-house perforated badly by this bee and should like to know what would keep them away.

X.

ANANTAPUR ; September 18, 1888.

### HORBURY'S PATENT LATRINES.

SIR,—With reference to the paragraph on the above subject which appears in your issue of the 22nd instant, we wish to say as manufacturers of the latrines, that the opinion therein expressed is certainly not endorsed by the majority of Executive Engineers, and by a large number of Municipal Committees from all parts of India. As a proof of this, we may mention that we have supplied them for almost every district in India, and that the number made in the last twelve months alone amounts to over 1,100.

We will be obliged if you will, in fairness to us, publish these remarks in your next issue.

RICHARDSON AND CRUDDAS.

BOMBAY ; September 25, 1888.

### A PLEA FOR ENGINEERS ON FAMINE RELIEF WORKS.

SIR,—I hope you will be able to find room in your columns for a few lines which I think may be of interest to a great many of your readers.

The Railway Committee is now sitting at Simla, and though this matter may not come within the scope of the proceedings, many members may be able to discuss the matter privately, especially as I believe the subject is one which has been mooted before.

I refer to a special allowance to Railway Engineers and Subordinates, especially to Subordinates who may sometimes be put in out-of-the-way places, far from all centres of civilization and where they spend year after year a lonely and isolated life and where their expenses are greatly enhanced owing to the difficulties of procuring sometimes the necessities of life from far distant towns. Our Railways now have to go further afield as yearly the net work spreads over the country, and we, the pioneers, are, I am sure, due some consideration at the hands of Government and the public. In the case of a famine how lavish is the expenditure to bring food grains to a starving people ; should not therefore the men on famine lines have some consideration from the same hands who scatter the rupees in time of trouble.

A famine line means a line which is run through a poor country, and which it is known cannot pay, and is often run through a wild waste with sparsely sprinkled villages and where the people have scarcely enough for themselves, let alone for outsiders. The slightest want of rain and the people and all around them are in a scare and food grains go up in price. Of course you will surmise that I am on a famine line, and if I mention one or two of our troubles you will see how badly we are off. Some of us get our bread carried 40 miles in a *dak* bag, as there is no means of making it in our parts. The bread is anything but good, and after a forty-mile travel in the sun in a leather bag on a coolie's back you can imagine what it is like. All food is scarce, and as the nearest towns are over 100 miles away, our few Europe stores cost us very heavy.

One of our Executives has tried to represent our case to Government, but I am sorry to say he has failed. Had our Chief put more heart into the matter it might have done better. The cold soda water bath it got at his hands was, I am afraid, its death-blow ; he made some facetious remarks in his report, which I am sure is a mistake in a question which is of vital importance to many. The reply of the local Government was a foregone conclusion and was very similar to the gorst and goselen reply we got the other day in Parliament. I am sure this matter only wants to be brought ably to the notice of Government to do us the justice we stand in need of, and which in all fairness cannot be denied.

FAMINE STRICKEN.

September 21, 1888.

### EQUALITY AND FRATERNITY.

SIR,—With reference to your article on "the position and prospects of Civil Engineers in the D. P. W." in your issue of the 15th instant, you would much oblige all men appointed in India if you would publish the Government of India Resolution of April 1876 which you refer to. This was I presume published in the *Government of India Gazette* and is therefore public property.

In your article referred to above you state "Most of these men (those appointed from the Indian Colleges) have since been admitted to the better pension rules, but not all"—this must have been written under a misapprehension, as none of the Indian College C.E's. have been admitted to the new pension rules. In thanking you for your advocacy of the just claims of the C.E's. as a body, I would beg your help on behalf of the men appointed from the Indian Colleges—the only class now which does not get the new pension rules. These men get the same pay and have the same duties and responsibilities as all others in every respect, consequently why should they be left out in the cold.

Many men of this class had been serving for nearly 20 years (some more) under the same rules as to pension, &c., as all others when the new rules were granted to the favored Secretary of State men.

W. H. JOHNSON,

Executive Engineer.

EDWARDESABAD, PUNJAB ; September 24, 1888.

### THE CULTIVATION OF SCIENCE IN INDIA.

SIR,—From a report of the proceedings at the eleventh annual meeting of the Indian Association for the Cultivation of Science, held in April last, a copy of which has reached me, it appears that, in addition to Chemistry and Physics, two new subjects, Mathematics and Geology, were lectured on last year, and I am told that the attendance at the lectures was very satisfactory. I rejoice to hear that to native ladies, as well as native gentlemen, they proved attractive. Altogether, 129 lectures were delivered during the year under review—and by such competent authorities as Father Lafont, Dr. Sircar, Dr. R. Sen, and Baboos Pramatha Nath Bose (of the Geological Survey), Jagadish Chandra Bose and Ram Chandra Datta.

The laboratory received accessions of scientific instruments—notably a pair of telephones and telephone transmitters, a ten-light Gramme's dynamo-electric machine, a Serrin's lamp, a large inductorium and a steam engine. The receipts for the year were a trifle over Rs. 16,000, and the balance sheet at the end of the year 1887 shewed Rs. 1,72,482-13-9 to the credit of the Association. And yet the Honorary Secretary, Dr. Mahendra Lal Sircar, is not happy. In his own words, "Perverse as it may appear, it is because of the favor and the patronage already received that I complain that the patronage has not been adequate for the end sought to be accomplished."

It does appear to me mightily perverse. I would recommend to the worthy Doctor rumination over the import of the Spanish proverb which suggests that when you cannot get what you want, it is just as well to make the best of what you have.

In another place, Dr. Mahendra Lal Sircar says:—"We have purchased instruments and apparatus as much as we could possibly get for Rs. 26,000. But it must be evident that they are but



as a drop in the ocean that we actually require for the purposes we have in view? It is by no means evident to me. If nothing short of an ocean of funds will appease the scientific hunger of young Bengal, I am afraid that young Bengal will have to wait for it till the millenium. Not thus did Humphrey Davy, and Michael Faraday, and Isaac Newton regard the matter of scientific education. They made the best they could of such tools and appliances as lay ready to their hands—often were fain to make the best of lack of either—with what success, their scientific achievements remain to shew. Dr. Mahendra Lal Sircar says:—We require funds to endow professorships, each of which will require about a lakh and half. We want funds for additional instruments and apparatus and books, which, with a building to locate them, will require at least a lakh of rupees. And we require funds out of the interest of which our collection of books and instruments must be added to from time to time, in order to enable our professors to keep pace with the progress of science.

These are very worthy and legitimate objects of ambition, but—Rome was not built in a day.

NESTOR.

## WIND ENGINES FOR INDIA.

### II.

WHAT must be done is to prevent the enormous waste of water which is allowed yearly, and devise some means or other for keeping it in store.

To do this power is required. Steam power would be the best, but even that is expensive, and the danger of putting engines and boilers into ignorant hands is great.

Water wheels would do, but they could only be used in places where there is a constant current.

There is only one thing left, and that is we must look to nature again.

When she fails us in giving rain, she must be made to help us in some other way.

WINDMILLS are the things for India, and there is no power in the world that costs so little as the power required to turn a windmill. India is a country suited for them, as there is hardly a day that there is not a slight breeze of some kind.

It is surprising that in a large country like this we never come across one of them, doing its work of usefulness. The advantages of a proper windmill system in this country would work wonders.

At present the tanks are mostly made on high lands so as in case of water being required for the crops, all the farmer does is to breach the banks and let the water flow down to the lower cultivated plots. When the tanks get dry there is no means of getting them refilled till the rains set in again. Now what is required is to have tanks constructed also in the low lying grounds, and in such places that the slightest shower will fill them by the water from higher levels. Windmills erected near these tanks could be made to force the water up to the higher level tanks. Another great advantage gained by this method would be that all water escaping from the fields could be made to run back into the lower tanks. Nullas are natural canals, and during the hot weather if a small bund is thrown across them there can always be enough water collected to be useful; at present all the high land water is allowed to go to waste.

There are fifty different uses to which windmills could be put for the benefit of the rural population—husking paddy, making flour, extracting oil, crushing sugarcane, pumping up good water from wells, &c., &c., which would in themselves pay for the machine over and over again. It is left to the zemindars themselves to carry out these reforms, and if the advantages to be gained are explained to them, I am certain they would co-operate in working out the system. In fact, they could make this another source of income.

Windmills cost very little to erect, and next to nothing for keeping in repair.

We all know what rapid strides the steam engine has made during the last few years, but I don't think many are aware what improvements have also been made in regard to wind engines. The old styles of mill we used to see in our younger days are fast dying out, and in their places have been erected mills of such automatic and simple design, that seeing them at work coming up to the wind themselves one would imagine that some one was in attendance.

It must be patent to nearly everyone living in the Mofussil that interest in rural life by natives of the upper classes is declining. Look at all the Indian colleges; they are overflowing with young men. Now where have most of these lads come from, and who are they? They are from the different towns and villages, sons of small zemindars and respectable farmers whose only aim in life is that their sons should serve the Government in some capacity or other, and that they should either study as doctors and lawyers, and what is the consequence, the professions are overdone, and this is the reason why there is so much discontent among the educated who think Government is very unjust if it does not find employment for them all. How many think of going back to their own village, and with the education they have received improving their property? Why very few, if any. A lad goes from his home and is placed in one of the colleges, he has not been there long before his few

wants become greater, and by the time he has finished his education feels too proud to live all his life amongst his ignorant kinsfolk.

It is true he goes home now and then, but it has lost all its boyish charms; his old friends and associates seem contemptible to him, he finds the place dull, and longs to be back amidst the busy men of the world. He goes back to town, and is not very flushed with cash, so to keep up appearances he resorts to mortgaging his property and contracting loans bearing exorbitant interest, and here is the secret of property which has been in the family for centuries changing hands and going over to the money-lender.

These are the men who for some better employment think themselves aggrieved, and take to writing bombastic letters to the different papers about oppression and the like, and by so doing are looked upon not only by Englishmen, but also by their fellow-countrymen with contempt. Some means should be devised for encouraging Agriculture, which would open out a large field for the dissatisfied, and they should be made to understand that this line of business is just as honourable and far more independent than most of the other professions.

The native nobility and gentry backed up by Government should establish a number of Agricultural colleges in all parts of India where young men could be trained and taught farming on the latest modern principles. The benefit of institutions like these would be immense. The student after finishing his course would then be eager to try in practice what he has learnt in theory, and with a class of men like these the social standing of the rural classes would be greatly improved.

The future prosperity of India is left with the natives themselves, and it is to the upper ten of Indian society that she must look to carry out these reforms, and if they only persevere in this branch of service, as they have done in others, India will owe them a debt of gratitude which she will never be able to repay.

LEPIDODENDRON.

## EQUALITY AND FRATERNITY.

SIR,—I have been expecting for some time, that one or other of the Civil Engineers appointed in India would make a move regarding the question of the improved pension rules. I refer of course to those Engineers who have not received the benefit of these latter rules. I cannot make out why men doing similar duties should be under different rules, and I maintain that pensions are granted for services performed, and for this reason only. This being so, why in the name of all that is just should there be two sets of pension rules (and two of furlough also) for men executing the same or similar work? Civil Engineers appointed from Colleges in India after passing the theoretical examination have, as a rule, to work two years before they are graded the same as men appointed from England. During these two years they are undergoing a course of practical training, and my experience is that after the time so spent, they are, as a rule, quite fitted for the rank of 2nd grade Assistant Engineer. If they are not, why are they after this time kept on the same roster for promotion, &c., as men appointed from England? In keeping all men on one roster the Government acknowledges that those Engineers appointed in India are of the same worth as servants as the Engineers from England.

I fancy all Civil Engineers in the Department are fully agreed that they ought to receive the same treatment as the R.E.s., but unless the claims of all C.E.s. to the same pension and furlough rules be primarily put forward, I cannot see how the R.E. question can be fairly agitated. What can it matter to the Government as to where their employes come from? If they can do the same work, and are of the same value as servants, surely their wage should be equal.

I would strongly advise all men who have not received the benefits of the improved pension rules to address the Civil Engineers' Defence Committee on the subject, and to urge that body to keep the question of equal treatment of all Civil Engineers well to the fore. Until we all receive the same pension and furlough rules, the Civil Engineers of the P. W. D. cannot possibly be united, and till united we cannot make headway against the unfair treatment we receive. I consider that the Committee should, in their address to Parliament, urge that pensions and furlough are granted for work done, and for work done only; and that irrespective of the style of the Engineer's recruitment. The Civil Engineers, who are under the old pension rules, are commencing to form a minority in the Department, and I regret to say I am beginning to feel that, as a minority, our claims to equal treatment are being quietly ignored by the majority. I trust I am wrong, and I hope that the Defence Committee will prove I am.

I must apologise for the length of my letter, but before finishing I should like to draw attention to the fact that although Government has heretofore not agreed to give the better pension rules to all those Engineers appointed in India, yet many of the latter are considered good enough to be elected as Members of the Institute of Civil Engineers, thereby proving that they are worthy members of the profession.

VIATOR.



## Literary Notices.

### GENERAL REPORT ON THE OPERATIONS OF THE SURVEY OF INDIA DEPARTMENT DURING 1886-87.

As a general rule, reports are dry reading, but this one is to a great extent free from this charge, containing as it does an Appendix which reads more like a book of travel than anything else.

The body of the report deals with the work of the several parties, and the Appendix is made up of extracts from the narrative reports sent in to head-quarters by the various executive officers. Of the twenty-five parties at work only one small party was employed in trigonometrical survey work: it was engaged in the secondary triangulation of the East Coast of India with the object of furnishing points as a basis for the future work of the Marine Survey Department, and as part of the scheme to complete the triangulation of the coasts of India and Burma over the parts left untouched by the principal triangulation.

It was unfortunately also found necessary to restrict the programme of the topographical survey so as to meet the demands for remunerative surveys in the Central Provinces. In consequence there were only eight parties employed as against ten in the preceding year, and the outturn of work was 17,510 square miles as against 19,162 square miles of the year before, while in addition 296 square miles of forest were surveyed on the 8-inch scale, and 46 square miles on the 4-inch scale.

One of these eight parties was engaged in the survey of the Nicobar Islands with the view of fixing their absolute position on the maps, and their relative positions in regard to each other, and also of obtaining an accurate outline of the coast to meet the requirements of navigation.

Astronomical latitudes were taken with a 14-inch theodolite, and the longitude of Kamorta was obtained differentially from Chatham Island by means of a battery of chronometers. This station is probably determined within 80 feet in latitude and 168 feet in longitude. This party was under the charge of Colonel G. Strachan, who gives some very interesting information regarding the islands and the manners and customs of the inhabitants. It is hard to keep from smiling when one reads of their favorite drink being a mixture of rum and castor oil. Owing to the fact that most of the islands are covered with dense forests, it was impossible to get much topographical detail in the short time that the party had at its disposal, but several high peaks were fixed ranging from one to two thousand feet in height. In addition to the survey of the Nicobar Islands a little extra work was done on Little Andaman Island, and its position on the Marine Chart was found to be considerably in error.

There were six Cadastral Survey parties at work during the season, giving a total area of 4,273 square miles surveyed. In the Gorakhpur party a new departure took place by the employment of village *patwaris* as surveyors instead of professional *amins*, and the change was found to work very well.

A survey of Calcutta was begun on the scale of 50 feet to 1 inch, in which, besides the ordinary particulars concerning streets and houses, the boundaries of the several properties which pay revenue to Government will be shewn.

The Traverse Survey parties continued their work in the Punjab and the Central Provinces and completed 6,085 square miles in the former province, and 10,576 square miles in the latter.

As there was only one officer available for astronomical work, latitude observations were resumed on the meridian of 80°, and completed by Lieutenant Burrard at five stations, bringing the work down to latitude 20° 13'. The observations had to be closed somewhat early to allow of experiments with the transit instruments, used in the electro-longitude operations, being undertaken at Dehra. These experiments, which were made to discover, if pos-

sible, the source of some puzzling errors which had been noticed in the previous season's work, are fully described by Lieutenant Burrard in the Appendix, and the description is a model of clear and exhaustive reasoning which will be welcomed by all interested in the subject of instrumental errors.

Tidal operations were continued at seventeen stations. One new observatory was added to the list by the establishment of a station at Akyab, but unfortunately the observatory of Dublat at the mouth of the Hooghly was swept away by a cyclone on 29th September 1886.

The results of the harmonic analysis of the observations, taken at those stations where the work is completed, are given in tabular form in the Appendix. The Tidal and levelling party also completed 450 miles of double spirit-levelling in the southern part of India.

Considerable additions were made to our geographical knowledge during the season both in Upper Burma and across the Himalayas. In the former district, two detachments were employed under Major Hobday and Colonel Woodthorpe, respectively, and between them an area of 15,284 square miles was reconnoitered on the quarter inch scale based on triangulation, and the various reconnaissances executed from time to time by military officers also incorporated in the maps.

The report of the explorations of M.-H. in Nepal and Thibet with a sketch map of his route was separately published. The present volume, however, contains a summary by Colonel Tanner of R. N.'s work in Eastern Thibet, together with a sketch map of Bhootan. A short account is also given of the work and adventures of K. P., a native of Sikkim, who was sent to Thibet in 1880 with a Chinese *Lama*, and was sold as a slave by the latter. He eventually managed to escape and reach India.

At the head-quarters offices a vast amount of work was thrown on the drawing office by the surveys and reconnaissances of the Afghan Boundary Commission. Considerable progress was made in the completion of the maps without interfering with the ordinary work, which was further increased by urgent demands for maps of Burma and Baluchistan. A series of statistical maps was also commenced shewing the areas of the principal crops grown in India, and considerable progress was made in the military and railway map in twelve sheets.

The photographic office was ably conducted by Colonel Waterhouse, and under his direction the processes of heliogravure made much progress. Two quarter sheets of the atlas of India were engraved directly by the aid of photography from manuscript drawings, and the results shew that the process is well adapted to take the place of hand engraving in maps in which the geographical information is incomplete, and likely to be superseded. In the Appendix will also be found specimens of collotype as applied to the reproduction of water-colour drawings, and illustrating the advantages of orthochromatic photography to which some attention was devoted.

It is a pity to tax a willing department above its powers, but that is exactly what the Government seems to be doing; for the Surveyor-General says that the existing strength of the senior division is insufficient to meet the strain put upon it; this strain is partly due to the appointments to fill existing vacancies having been withheld, and partly to the expansion of the military programme, and to the extra demands which are now made for officers to accompany military and political expeditions. This is a state of things which ought to be remedied, especially as the newly acquired province of Upper Burma will require to be regularly surveyed at no distant date.

There were some changes in the *personnel* of the department during the year: Lieutenant-Colonel T. T. Carter, R.E., retired after 25 years service in the department, and the post of Surveyor-General was rendered vacant by the sad death of Colonel DeFree, whose connection with the survey extended over a period of no less than 32 years. Lieutenant-Colonel H. R. Thuillier, R.E., who was officiating for Colonel DeFree was appointed to fill his place, and under his directions the present report was compiled.



## General Articles.

### TYPES OF IRON GIRDER BRIDGES, INDIAN MIDLAND RAILWAY.

WE furnish the fourth of the series of Plates giving details of the main girders of these Bridges. The Drawings, as said before, are self-explanatory. The annexed Plate refers to the 150 feet clear span through bridge, some particulars relative to which will be found in our issue of 25th August last.

### BICYCLE RUNNING.

BY A. EWBANK.

#### II.

THE single rolling wheel with its plane vertical has really two distinct velocities. It has a linear or forward velocity, say due north. Let us suppose this to be 10 miles per hour. It has an angular velocity or rotational speed. The axis of this rotation is horizontal. The rotation is such that the plane of the wheel, or of one face of the wheel, does not change. The axis of the rotation is normal to the wheel plane. Suppose the angular velocity to be such that a particular point on the outside of the tire, which is now the highest point of the wheel, will again become the highest point after the lapse of one second of time.

The linear and angular velocities are related to each other if the diameter of the wheel is previously given. As we have arbitrarily selected the linear velocity as 10 miles per hour, and the angular velocity or spin as one rotation per second, we have indirectly chosen for our wheel some particular size which we do not here stop to calculate.

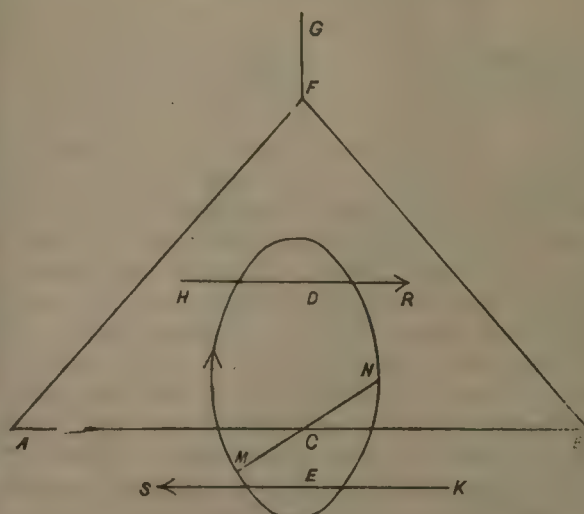
As the wheel has acquired increased stability, the question arises to which one of the two velocities—the linear and the angular—should this enhanced stability be attributed?

To determine this question, we might give the wheel a forward velocity of 10 miles per hour without giving it any spin. We could do this by putting the wheel on a truck and moving the truck on a level road. If we do so, we shall find that the accidental joltings to which the wheel is subject will speedily upset it. A more accurate method would be to place the wheel on the deck of a barge which is towed in a smooth lake or river by a little steam tug.

This motion would be much smoother than that along an ordinary road. We could then deliver small blows *R* to the wheel and normal to its plan. We should find that the magnitude of an upsetting blow is just the same as it was when the wheel was at rest. Our conclusion would then be that the linear velocity of the wheel did in no way affect its stability. It remains, therefore, to examine the spin or rotational velocity when this is unaccompanied with any forward velocity.

The reader would perhaps suggest that the wheel should be raised above the ground, and a fixed axis running normally through its centre should be arranged in bearings. This arrangement does indeed enable us to give the wheel a rapid spin, while its centre has no forward velocity. But the arrangement is of no use to us for the purposes of our inquiry. The fixed axis will compel the wheel to keep its plane fixed. It cannot, therefore, yield to any blow. If we deliver a blow *R*, we cause stresses and straining at the places where the axis lies in its bearings. The bearings resist these stresses and the wheel continues to move approximately as it moved before. The word approximately is introduced into the preceding sentence, because there is always some "play" at the bearings. In spite, however, of this play, the bearings do mainly control the wheel and prevent it from yielding to the blow *R*, even if it was inclined to yield. It is this possible inclination to yield which is the very thing in question. We must, therefore, contrive a more moveable axis.

Fig. 1.



In *fig. 1* the wheel is suspended from a fixed point *G*. *G F* is a long fine cord, the figure being not drawn to scale. *F A*, *F B* are thin rods of wood or metal. *A C B* is a horizontal rod of metal. This rod is not meant to turn with the wheel in the way an axle sometimes turns. In other words, it is not fastened to the wheel. It passes loosely through the wheel at its centre, so that the wheel turns on this fixed axle *A B*. The masses of the rods *A F*, *B F*, and *A B* are small separately and collectively compared with the mass of the wheel.

Matters being thus arranged, choose a point *D* which now is not at the centre of the wheel. Let *D* be vertically over *C*. At *D* let us deliver a slight blow *R* parallel to *A B*. By the line *A B* we do not mean the line *B A*. Let the plane of the wheel be in the meridian of the place. Let *A B* point due east. Then *B A* points due west. In Geometry, a line *A B* may mean the same thing as a line *B A*. For each may be a collection of points fixed in space. In Dynamics, however, a line *A B* connotes, or implies, or suggests a movement from *A* towards *B*.

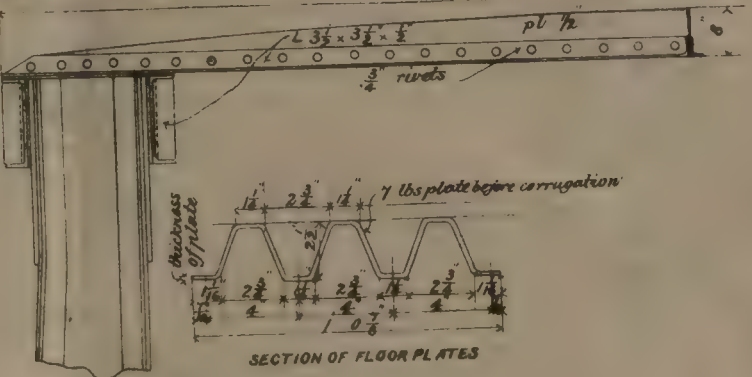
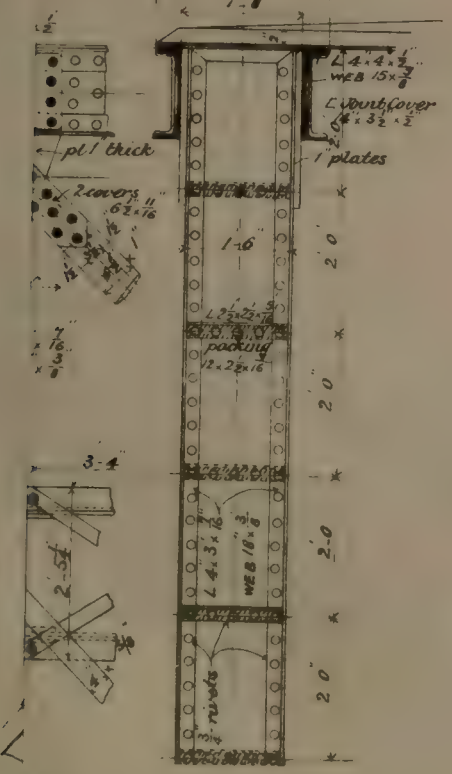
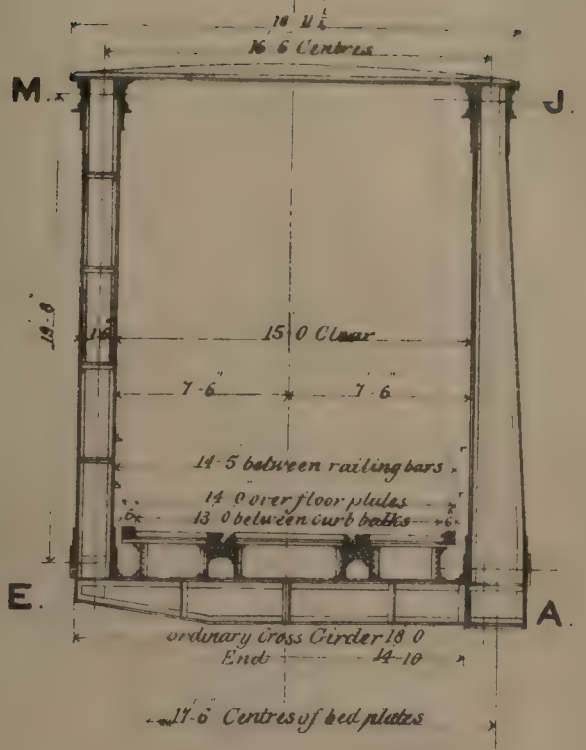
Let then a blow *R* be delivered as is indicated in the figure. In consequence of the blow the points *A*, *B*, *F* of the body will all receive motions which have horizontal components towards the right, that is eastwards. If the total motions of *A*, *B* and *F* were parallel in direction and equal in magnitude, the whole apparatus *F A B* would move forwards without rotation. Such a motion is called a motion of pure translation. If, however, the total initial velocities of the three points *A*, *B*, *F* OF THE BODY are not thus perfectly equal, there will be some rotation.

In fact, the extremity *A* of the rod *A B* will slope upwards to the right. The extremity *B* will move downwards. We do not assert that it will slope downwards to the right, or downwards to the left, or move vertically downwards.

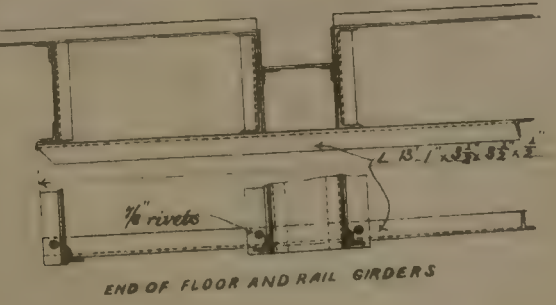
For the movement of *B* will depend partly on the length of *C B* when the mass and dimensions of the wheel are known. The point *F* will move horizontally eastwards. It must be noted that these motions are merely the initial motions. They are the first movements or velocities which the apparatus acquires the moment after the blow *R* is delivered. The centre *C* of the wheel will have an initial horizontal movement, the same as that of *F* in direction, but less in magnitude.

Now we wish to have *C* initially at rest and, therefore, a single blow *R* is not suitable. We, therefore, choose a point *E* on *D C* produced, and such that *D C = C E*. At *E* we deliver a blow *S* equal to *R* in magnitude, but opposite in direction. We can now more precisely describe the movement of the extremity *B*. *A* will now initially move vertically upwards. *B* will initially move vertically downwards. *C* will be at rest. *F* initially will move horizontally and eastwards.





SIDE FLOOR PLATES N# 324 P# SPAN









If, instead of having F G a long fine cord, we have it a short thick cord, the subsequent motions of A, B, F will be different from what they will be with F G long and fine. But with such subsequent motions we are not concerned, nor need we give the magnitude of the initial upward velocity of A. It will depend on the blows R and S, on the positions of D and E, on the mass and diameter of the wheel, and on other elements.

The initial movement of the wheel is a movement or rotation about a line M N, which passes through C and points due north. This rotation we may call an upsetting rotation. The wheel plane leaves the meridian and takes a sloping position. If the wheel were not interfered with by a tension along the string F G, it would rotate continuously in the same direction as that in which it commences to rotate.

The reader, looking at the figure, will see that we may describe the rotation as a clockwise rotation. Sometimes a clockwise rotation is called right-handed. Then a counter-clockwise rotation is called left-handed.

Now replace the wheel on its original meridian position, and give it in its own plane a rapid rotation such as is indicated by the arrow W. A rotation opposite to W would do equally well for our inquiry. The wheel turns about the rod A B, which itself does not turn nor move in any way. Thus the points A and B remain at rest, and so does the point F or the string F G. Had we fixed A B to the wheel, the end A would have to turn, and this would introduce a stress at A. We might, however, have fixed A B to the wheel if we made A B turn in bearings at A and B. We should then have these bearings connected with F by the rods F A and F B. The arrangement of the figure is the simpler.

As the wheel revolves, the points D, E are whirled around. At certain times they re-occupy their original positions for a moment.

It is at one such moment that we will suppose the former blows R and S to be delivered. If the wheel under the influence of R and S should endeavour, with its centre at rest, to rotate clockwise through any angle which is not very small, the string G F will resist such rotation. For the rotation could only take place if the string were lengthened. Conversely, if we find that the wheel does not move far from its original position, we cannot give the credit of such approximate steadiness wholly, or even mainly, to any steadiness inherent in the wheel by virtue of its W rotation. In order to measure this possible inherent steadiness, we must cut the string immediately after the blows R and S are delivered and so leave the wheel free to turn if the forces upon it tend to make it turn.

If we cut the string, the wheel falls. But we can easily distinguish between the falling motion and the motions we are studying. We only need a little time to elapse before the wheel strikes the ground and so ends the experiment.

Let the wheel be suspended not less than 16 feet above the ground or floor. Then it will take not less than one second to fall. If the W rotation is sufficiently rapid, the wheel will execute several of the W revolutions in one second. The mere falling of the wheel would carry it down with the line A B at a constant angle to the horizon. If the wheel suffers from the blows R S, their effects can be studied by watching the line C B. The line C A would do equally well. When the wheel is suspended, the point B is originally at rest. The W rotation has no effect on B. The function of B is to ignore any movements of the wheel points in their own plane which is initially the plane of the meridian. So long as the point C remains undisturbed and the direction of the wheel plane is unchanged, B will be fixed.

But if the wheel plane itself changes its direction, the point B immediately proclaims the fact. C B is the normal to the wheel plane. Accordingly whatever angle the wheel plane makes with a vertical line, the same angle will C B make with a horizontal plane.

It suffices, therefore, to study the behaviour of C B

while the wheel is falling. If the line C B begins to slope downwards and continuously increases its slope, we must infer that the wheel has obtained from the blows R and S a continuous clockwise rotation. If the line C B slopes only a little downwards, then again becomes horizontal, and then slopes upwards, we shall infer that the wheel has taken a motion which we before described as wobbling. The directions which the line C B make with the horizon will, in fact, be found to be of this changeful or oscillatory character.

Instead of watching C B, we may, of course, watch the wheel directly. The angular movements of the wheel are really the result of the effect of the blow combined with the original W rotation. The movements of C B are simpler because the W rotation does not affect it. If this experiment is duly pondered, we shall see that it proves that the steadiness of a rolling wheel is due solely to its rotatory movement.

## NOTES ON A TRIAL OF JOY'S VALVE GEAR

### FITTED ON AN "N" CLASS ENGINE,

#### METRE GAUGE.

By FRANK GOODWIN, DISTRICT LOCO. SUPERINTENDENT,  
R. M. S. R.

LOCOMOTIVE Engineers well know that the ordinary valve gear of this type of engine, with its short wheel base, must necessarily be very cramped, and that the eccentric rods must work at a very extreme angle, while any up and down motion or movement of the driving axle (either temporary through inequalities in the permanent way, or permanent through the set of the springs or wear of the bearings) at once affects the set of the valves.

It was thought that valve gear on Joy's principle would get over this difficulty, and accordingly a set of Joy's gear was fitted to an "N" class, and a trial instituted between the engine so fitted, and another engine of a similar type, but with the ordinary valve gear. The trial was made with a picked driver who had charge of both engines, and took them out on alternate days over the same trip, and with, as far as possible, the same loads. The stretch of line over which the trial was conducted is  $55\frac{1}{2}$  miles long, and the up journey is mostly a steady pull with frequent grades of  $\frac{1}{100}$ , and the last 10 miles is a heavy pull up grades of  $\frac{1}{200}$  and  $\frac{1}{100}$ . A trip consists of the journey up and down again. The load on the up journey was always a full one, but on the down journey the engine often came back with a short load, but it has been found by previous experiments that as the grades on the down journey are mostly favorable to the engine, a light engine and an engine with a full load burn nearly the same amount of coal, as the weight of the load pushes the engine down the banks.

The average speed of the train was  $12\frac{1}{2}$  miles an hour, and the engines were first tried with a load of 30 loaded wagons (equal to a gross weight of 300 tons) and then with a load of 35 wagons (a gross weight of 350 tons).

It will be seen by the appended memo. of results that the Joy's gear shews up very favorably in both trials, and gave a saving of 1.71 lbs. of coal per mile in the 30 load trial, and an even better result in the 35 load trial by beating the ordinary gear by 3.85 lbs. a mile.

The coal used was Bengal steam coal and was carefully weighed during the trial. The trial was not long enough to decide on the merits of the two gears with regard to wear and tear and repairs, and during the trial neither of the engines required any repairs.

The cost of a set of Joy's gear adapted for this type of engine is approximately Rs. 1,930, and the cost of fitting same to engine Rs. 150.



Comparative statement shewing result of trials of consumption of coal by "N." class Engines fitted with Joy's gear versus ordinary gear.

	No. of vehicles hauled per train.	Total Engine miles.	Total vehicle miles.	Total coal consumed.	Consumption of coal per	
					Engine mile.	100 vehicles miles.
Engine fitted with Joy's gear	30	1,716	43,276	21.4	27.93	110.77
Engine fitted with ordinary gear	53	566	15,327	8.4	33.24	122.76
Engine fitted with Joy's gear	30	1,723	42,085	22.8	29.64	121.35
Engine fitted with ordinary gear	35	628	18,496	10.4	37.09	126.00

F. G.

### HINTS FOR THE ERECTION OF LATTICE GIRDERS.

By H. B. MOLESWORTH, LATE ASSISTANT ENGINEER,  
P. W. D.

120 feet span, made by Finch and Co., Chapston, London, and similar girders.

It may appear at first sight useless to give hints for the erection of girders; but as some difficulties were at first experienced in erecting these girders, and hence some loss of time, a few notes on the practical experience gained may possibly be of value.

These girders are on sliding plates, and are hence awkward to jack. It is therefore advisable to build them in position when possible.

The struts from each end to about 30 feet from the pier are braced. This bracing is made of bar iron bent to the required shape as shewn in *fig. 1*.

These bracings are in all cases put in last. After all the lattice work has been erected they may be put in either of two ways.

They may be rivetted together as shewn in *fig. 2*, and slipped down over the top of the lattice work before the top boom is put on.

*Fig. 3* shews an alternative way of putting on the bracing of the struts after the top boom has been put on.

They are placed as shewn by the dotted lines, rivetted together in that position, and then slipped down into place. I devised a clip for holding the two bars together, which is shewn in *fig. 4*, and is shewn in position at *a* in *fig. 3*.

For rivetting the struts and ties together, I also devised the clip shewn in *fig. 5*, which is shewn in position at *b* in *fig. 3*.

The forked piece *A* was put in position, and the clip *B* driven up on it until it was tight. As these rivets passed through the tie, a washer, the bracing and the strut, and there was no second hole to put a bolt or drift in, some such contrivance was wanted.

Some slight confusion was caused by an error in the drawings, which omitted to shew the centre gusset plates of the lattice work. This, however, was soon discovered and remedied.

The cross bracing between the girders must be put on before the top boom, as it cannot be put on afterwards.

### TRICHINOPOLY WATER-SUPPLY.

THE Board of the South Indian Railway, having approved of the proposal for obtaining an unfailing supply of good water from the river Cauvery, the Directors further suggested that it might be desirable to ascertain whether by an extension or enlargement of the proposed scheme, the same source would not supply the town of Trichinopoly with water, and so reduce the expense of

the Company, and even perhaps in time produce a profit sufficient to repay the outlay, and whether if this be practicable the Municipality would join in the expense.

It was suggested that the construction of the wells, the obtaining of the requisite pumping engines, piping, &c., should be undertaken by the Company, and that the cost thereof should be borne by the Company and the Municipality in proportion to the quantity of water estimated to be required by each. The working and maintenance of the engines, pipes, &c., should be undertaken by the Company, and the cost thereof borne in like manner by the Municipality and the Company. The arrangement for obtaining from the Cauvery a supply of water to meet the Company's requirement only, is estimated at Rs. 57,742.

The Municipal Commission in the meanwhile had considered the rough lines of a project estimated to cost Rs. 2,50,000; they have approved of the matter being gone into in detail; have found the necessary funds for carrying the proposal out; and, I believe, the matter will be placed before Government in the Local Fund and Municipal Department in the course of a few days.

The Consulting Engineer considered it desirable that the working arrangements should be in the hands of the Company, who have a trained mechanical staff always available.

The Collector endorsed this view—saying:—"Joint action with the South Indian Railway Company will be an immense advantage in the management of the pumping station, and, unless immediate action can be taken, this chance will be lost."

The Trichinopoly Municipal Council unanimously adopted the following report regarding a water-supply project for the town to be carried out conjointly with the South Indian Railway:—

The water-supply of the town of Trichinopoly is at present derived from the Wyacondan channel, which traverses the southern extremity of its main portion at a level about 28 feet above that of the bed of the Cauvery. The site of the old fort, the most densely-populated and important part of the town, occupies a ridge running north and south between the channel and the rock and sloping gently towards the east and west. The system, under which this part of the Municipality receives its water-supply, is very simple. Two main supply channels take off from the Wyacondan at suitable points opposite the two slopes of the ridge just referred to and run parallel thereto towards the river. From these channels, branches run in underground tunnels towards the ridge and discharge into series of deep reservoirs amongst the houses from which the water is drawn for use. The primary channels are mere open streams and are of course in a position to intercept the drainage from the town, and though arrangements have been made to pass it underneath them these are of a very partial nature. The channels have also been much neglected and their banks have at times been little better than public latrines. South of the Wyacondan channel, and on the continuation of the ridge on which the fort stands, are two populous areas known as Shengolam and Marsackpetta, which abut on the European and Military portion of the Municipality. They have practically no water-supply at all and are about the most cholera-stricken localities in the whole town. The water project, now under consideration, is intended, in the first instance, for the supply of these areas, the population of which is about 64,000.

The disadvantages, from which the water-supply described above suffers, are the following:—

1st.—It is drawn from the Wyacondan channel at a point about 18 miles from its origin. Throughout this distance, it runs nearly parallel to the Cauvery, receiving all the land drainage which would otherwise flow into the river. The existence of several villages on its banks on the inland side and the fact that it is commonly used for washing and similar purposes throughout its length add to this disadvantage and render its water extremely



HINTS FOR THE ERECTION OF LATTICE GIRDERS.

Fig. 1.

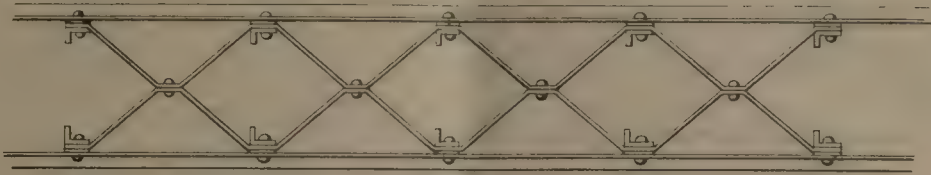


Fig. 2.



Fig. 3.

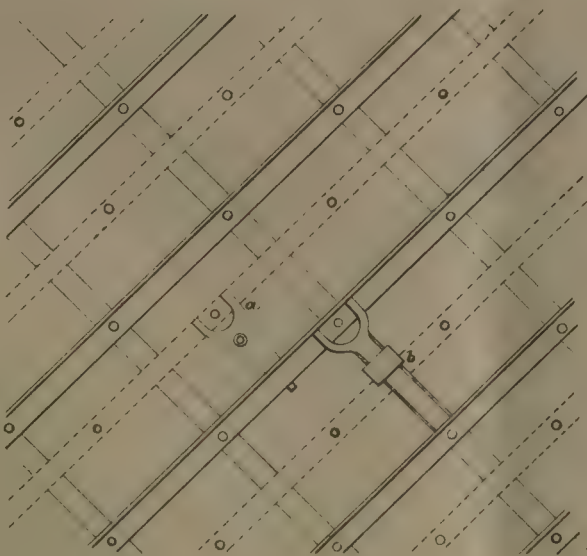


Fig. 4.

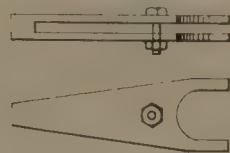
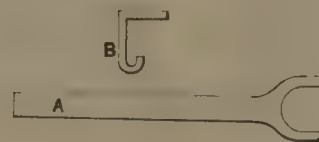


Fig. 5.









impure before it reaches Trichinopoly at all. Its supply is also uncertain and scanty in the hot season, when the channel sometimes has to be closed for repair.

2nd.—The open channels, which conduct the water from the Wyacondan to the town system of tanks, are terribly liable to pollution and receive a considerable proportion of the drainage of the town in wet weather.

3rd.—The levels only allow of the water being delivered into deep tanks amongst the houses into which there must be a large amount of infiltration of drainage from the subsoil which has been permeated by the leakage from cess-pools and subject to other causes of pollution for ages. The tunnels which connect these tanks pass through most objectionable localities (one runs under a large burial-ground) and the sediment which accumulates in them is of a very foul description.

The Chairman of the Municipal Council applied to Government for the services of an Engineer to investigate a water and drainage project; but, the Council was directed to make its own arrangements for securing the services of a qualified person for the purpose. Advertisements were accordingly published and a large number of applications were received; but, as the Council considered that the employment of any one who had not special experience in sanitary engineering would be a waste of money and as none of the applicants appeared to have any special qualifications of the sort, nothing further could be done at the time. Subsequently the Acting Collector succeeded in securing the services of Messrs. Oldham Brothers of Calcutta for the work under circumstances which provided for all that could be desired in the way of special knowledge on the subject, and arrangements were made for a short visit from Mr. R. Oldham in April last. Meanwhile levels, which had been taken by Major Drake-Brockman some years before in preparing his drainage scheme, were connected with the most important points on the channel and the Cauvery and plotted on the large scale Municipal map and all arrangements made to facilitate his investigations.

The first question which had to be considered was, whether the defects in the existing system could be remedied at a moderate cost and the advantage offered by the commanding position of the Wyacondan channel (28 feet or so above the river) utilised. The leading faults of the present system have just been described. The conclusion arrived at as regards each was as follows:—

The first may be regarded as beyond control. The water in the Wyacondan channel might possibly be conserved against pollution arising from using it for washing purposes and the like; but the physical features of the country render it impossible to avoid its being the recipient of the drainage from the south throughout the whole of its course.

The second source of pollution might be ameliorated a good deal by the construction of new supply channels (the site of the present ones is saturated with filth) with proper arrangements for passing drainage under them. It would, however, always have to be an open channel, as the fall is too small to allow of pipes of any reasonable dimensions being used.

The third defect could only be remedied by the establishment of a pumping station on the Wyacondan channel to allow of the delivery of water on a reasonable level (which would also get over the second drawback).

The possible improvement on the present system, without pumping operations, is therefore confined to a small measure of conservancy in the upper course of the Wyacondan—a measure which would be resisted, very possibly successfully, by the inhabitants of the adjoining villages—and the reconstruction of the two primary supply channels. This would effect a considerable improvement; but it would still leave the supply very foul and dangerous to health, and precarious and scanty in the hot weather, while Marsackpetta and Shengolam, two of the worst localities, would be left as badly off as ever. If pumping operations are resorted to, all the defects except those due to want of conservancy of

the Wyacondan and occasional scanty supply would disappear, but, roughly speaking, the cost of such a system would only fall short of that of one relying directly on the Cauvery itself by the cost of somewhat more powerful engines and a slightly longer main pipe. At first sight it may appear that there would be a large saving in piping in favor of the former, but this would not be the case unless a reservoir were dispensed with, as the nearest site for one would be the high ground in the cantonment south of the channel; whereas with a system drawing its supply from the river, the Trichinopoly rock itself would afford an excellent site not far out of the line the main pipe would naturally adopt. A reservoir might of course be dispensed with, but a system of delivery in pipes without one would be a very dangerous one, as the slightest accident to the machinery would force the population to resort to the wells and tanks which had fallen into disuse and become foul.

A project of pumping from the Cauvery being thus shewn to be the only reasonable solution of the problem, its main features follow as a matter of course, *viz.*, a pumping station for the collection of the water required from wells in the bed of the river, a reservoir on a suitable position on the rock and a system of distributing pipes therefrom. The position which the wells should occupy is settled by the Kodamurity river, which runs into the Cauvery about  $\frac{3}{4}$  of a mile above the Cauvery bridge. This river drains, amongst other areas, the densely-populated and cholera-infested tract between the Wyacondan channel and the Cauvery, and its drainage must therefore be avoided by placing the wells above its junction. From this point no drainage falls into the Cauvery for a distance of 15 miles up its course. The main would follow the course of the Railway up to the Fort station, where it would turn to the east and run along the southern face of the rock to its south-eastern corner. Here, on a slightly sloping shoulder about 50 feet above the ridge on which the town is built, is an excellent site for a reservoir. A certain amount of quarrying will be necessary to level the floor, but this will not be a serious source of expenditure, as the stone removed will be required for the walls of the cistern. It would probably be found advisable to construct it of a size to hold three days' supply, or 1,920,000 gallons, at 10 gallons per head per diem which would be equivalent to a depth of 16 feet over an area of 200 feet x 100 feet. From this the distributing system would run to the parts of the town mentioned above. The European portion of the cantonment would, of course, be omitted, as would also be the Regimental lines, but a supply to the latter could be arranged for, if the Military Department thought it worth the expenditure. The western suburbs of Puttur, Tennur and Worriore would also be excluded for the present, but this would only be a temporary deprivation, as the engine, main and cistern would be capable of supplying them also. The extension of the scheme to this part of the town is postponed merely to keep the size of the original project within bounds. A supply will be afforded to these sections—as far as the water-rate they can contribute will allow—as soon as the main project has been got into working order. It is not proposed to filter the water, because this would involve two pumping operations, the cost of which would be prohibitive. It is hoped, however, that infiltration through the bed of the river into the wells will of itself go far towards filtration. The quality of the river water also has not been ascertained by analysis, but it is not thought necessary to delay the execution of the scheme for this purpose, as the river is the only supply available. It does not require analysis to show that it is purer than that of the Wyacondan channel, the only other possible source of supply.

The possibility of a combination with the South Indian Railway Company was discussed with the Agent and Chief Engineer by the Acting Collector and Mr. Oldham, and there appears every reason to suppose that an



arrangement can be made. The form it would probably take would be that the Municipality and Railway Company would contribute towards the cost of the wells, pumping station and the main as far as the Fort station in proportion to their requirements, while the remaining works needed by each would be separately provided for. The Company would probably desire to have the working of the pumps in their hands—an arrangement which would be very advantageous to the Municipality, as it would place the mechanical resources of the Railway at their disposal. The working expenses would be divided between them in fair proportions.

Mr. Oldham's estimate of the cost of this scheme may be taken at Rs. 2,50,000. A deduction would probably have to be made from this for the share of the head works chargeable to the Railway Company, but the information supplied on this point is not very clear and the Council think it safer to adopt the larger sum. The working expenses for the complete scheme—including the extension to Worriore, Puttur and Tennur—are set at Rs. 12,000 per annum. This includes the share payable by the Railway Company. For the more limited project, which it is proposed to undertake in the first instance, Rs. 8,000 may be set down as the proportion to be paid by the Municipal Council. If the project is extended, it should be on the understanding that the additional water-rate will cover the increased expenditure. Supposing the capital required can be raised at 6 per cent., including sinking fund, as the Council hope to be able to do, the annual cost of the scheme will be as follows:—

	Rs.
Interest and sinking fund on Rs. 2,50,000 at 6 per cent. ... ..	15,000
Working charges ... ..	8,000
Depreciation ... ..	3,000
<b>Total Rs.</b>	<b>26,000</b>

The Council is of the opinion that, bearing in mind that the introduction of a costly water scheme without an efficient measure for drainage would be only a partial remedy for the evils from which the town now suffers and that the benefits conferred by the former will present themselves to the population in a much more tangible form than those to be derived from drainage, it is advisable to meet the cost of the project from an increase to its income specially intended for the purpose and draw as little as possible on its present surplus income.

The Government approve generally of the outlines of a water-supply scheme proposed by the Collector and the Municipal Council of Trichinopoly, and consider that detailed plans and estimates should be prepared to be considered in due course by the Public Works Department.

As regards the proposed co-operation of the South Indian Railway, the Railway Department have been informed that if a satisfactory arrangement can be made between the Railway and the Municipality, the Government will be prepared to sanction it

## BANGALORE WATER-SUPPLY.

ESSAY CONTRIBUTED BY S. TOMLINSON, ASSOC. M.  
INST. C. E., F. R. MET. SOC.

*Deputy Executive Engineer, Municipal Water-Works  
Bombay.*

### II.

14. THE site of the service reservoir would be between the new low level channel recently constructed and the south-east inlet channel and the levels and ground are favorable. The reservoir walls should be constructed of masonry or concrete resting on a concrete floor.

Where excavation is so cheap, it would probably be economical to have the reservoir below ground level, and the quantities allow for the full excavation required. The walls are of sufficient strength to carry the strains on them whether the reservoir be full or empty.

15. The filters would be near the service reservoir on the outlet side. The outlet side is preferable, because then the water would never see daylight again until it reached the consumers; and the service reservoir would act as a settling basin. The rate of filtration should be fixed at 4 inches per hour or 50 gallons per a foot of filter surface per day. For 78,000 gallons per day, 1760 s. feet would thus be required. Three filters  $4'0" \times 20' = 800$  s. feet each, would thus be able to do the work, leaving practically always one for cleaning and aëration. Filters of sand would, the author believes, be found quite efficient.

16. It will have been noticed that the water cannot pass to the top of the service reservoir from Ooperhalli until the water in the latter is at 90, or upper sluice level and in years of drought the water might not rise to this level. It becomes necessary therefore to examine carefully the capabilities of the large reservoir in view of the modification proposed.

It should be noticed—

- (1). That the average yield per annum is 26,200,000 c. feet. The minimum 16,920,000 c. feet.
- (2). The requirements of the troops is 3,500,000 c. feet.
- (3). The Evaporation at  $\frac{1}{8}$ " per day for 365 days is  $45'625"$ , say 4 feet, equal say 5,000,000 c. feet. The quantity is taken as being so low because the level of the water in the reservoir would be low in such a season, and 4 feet evaporation, at say 85 of reservoir gauge, would be 4,620,000 c. feet.
- (4). There would thus be left a balance of 8,420,000 c. feet.

17. The author proposes to ensure the filling of the service reservoir by—

- (1). A gravitation connection from the low level sluice outlet pipe to the service reservoir, whereby the water in the service reservoir would be at the same level as in the large reservoir. The bottom of the service reservoir being at 3010'50, or about 80 on reservoir gauge would commence to receive water when (supposing the reservoir to be at 75 = 3004'50 low sluice outlet when rains commenced) about 12 millions c. feet had been collected in. Under the most unfavourable circumstances, therefore, i.e., an empty reservoir to begin with, and a minimum supply to it to follow, the service reservoir would receive some supply by gravitation, and the quantity available would more than suffice for the troops.
- (2). To provide for the service reservoir being filled at all times, a hydraulic ram should be placed on the low level sluice outlet, which would lift a portion of the water at all times, when the reservoir was over 75 reservoir datum, into the service reservoir. The waste water from the ram would flow along the new low level channel as at present. It will be noticed that whilst the ram could, if thought necessary, be utilized at any time, it would only be necessary, when the water level fell, or threatened to fall, below 80 reservoir datum, or 3009'50. Above this level the gravitation connection would keep a supply in the service reservoir. This (80) is a level which has never been seen since the reservoir was com-



pleted, and could only be reached by a much greater draft of water in future from the reservoir. As a rule, the reservoir would be filled by gravitation without any difficulty.

18. The author believes that the scheme, as already sketched, provides a pure water in sufficient quantity and is workable, involving the minimum of supervision and depending for its success upon simple and well tried expedients. It remains to examine the scheme financially.

19. The author has pre-supposed that the Mysore Government would accord favorable consideration to any proposals the Supreme Government might make. The proposals might take two forms:—

(a.) To pay a fixed rate per 1,000 gallons for the water received from Ooperhalli Reservoir.

(b.) To acquire Ooperhalli works outright and dispose of the surplus water on the best terms obtainable, either for irrigation or the supply of the station or pettah Municipality.

(a.) The average yield of the water is 26,200,000 c. feet = 163,750,000 gallons. The cost of the works was, it appears, about  $5\frac{1}{2}$  lakhs of rupees. The interest and sinking fund on this sum at 4% is Rs. 22,000 per annum; @ 5% Rs. 27,500. This gives a cost of about  $2\frac{1}{2}$  annas per 1,000 gallons. Allowing one fourth for loss by evaporation, the rate is just under  $3\frac{1}{2}$  annas per 1,000 gallons. The consumption from Halsur has been 13,165,000 c. feet in four years (page 91 B. W.-S. compilation). The annual payment for water on this basis would thus be Rs. 4,500. At a calculated consumption of 60,000 gallons per day, the sum would be, say, Rs. 4,800 per annum. It does not appear necessary at this stage to go further into calculations on this basis.

(b.) If the Supreme Government acquire the works outright the onus would fall upon them to dispose profitably of the large surplus of water left, even in unfavorable seasons, after supplying the troops. The author does not believe there is any difficulty in this question, and the transaction might even become a favorable one.

20. The estimated cost of the additional works is now to be considered. These are—

(1). 6" main, 20,000 feet long.

(2). Service reservoir and filters.

(3). Connections between outlets of large reservoir and the service reservoir, including providing ram.

1. *The 6" Main.*—The author has selected a 6" main as best meeting the requirements of first cost, delivery and height of service Reservoir. The mains should be laid 2' 6" under ground: the trench will therefore be 3' deep. The course of the delivery channel from Ooperhalli to Cathcart Road being tortuous, a new line would be more economical, regard being paid to the hydraulic mean gradient.

The mains will be under very small pressure, and the minimum thickness of metal consistent with safety of carriage from England may be used.

Plain spigot and socket pipes are, the author believes, preferable to turned and bored ones. After leaving Cathcart Road the main would proceed along Cunningham and Hospital Roads to the E. I. Barracks. The minimum thickness of metal may be taken  $\frac{3}{8}$  inch. The weight per pipe of 9 feet, 2cwts. 7lbs. The weight for 20,000 feet will be tons 229, cwt 4—say tons 230.

The cost per ton is taken in the compilation at Rs. 95; and this figure is adopted. The cost of regular pipes will be, therefore, Rs. 21,850. To this should be added 10 summit and cleansing hydrants, four 6" sluice valves, and 5 tons of special castings, at say Rs. 160 per ton. This will add Rs. 1,250. Total cost of iron-work will thus be Rs. 23,100.

The laying, according to rates at page 197 of compila-

tion, is 3'4 annas per foot. The author thinks, however, that 4 annas should be taken. For 20,000 feet the amount will be Rs. 5,000. The total cost of main and laying will therefore amount to Rs. 28,100.

2. *Service Reservoir and Filters.*—The service reservoir should be circular. The area required is 360,000 s. feet, diameter say 680 feet, area 363,169 s. feet. The length of the wall will be 2,136'29 feet. The section of the wall will be 48'5 s. feet. The cubic contents will thus be 103,610 c. feet. At Rs. 14-1-0 per 100 c. feet (*vide*, page 192 of compilation) the cost will be Rs. 14,570.

The floor should be concreted 1 foot in thickness. The concrete will be 3,632 brass, (100 c. ft.) and the cost at Rs. 13 per brass will be Rs. 47,216.

The filter area required will be 2,400 s. feet. At Rs. 2-0-0 per s. foot the cost will be Rs. 4,800.

The excavation will be 4,098,000 c. feet at Rs. 4 per 1,000 c. feet = Rs. 16,392.

3. *The connection Works.*—The connection works will not be a heavy item. The outlets are already made; a Blake's ram will cost £200. This may be called, delivered and fixed ... Rs. 3,750

The connection pipes, and sluice valves complete ... 600

Total Rs. 4,350

The total cost of the works will thus be:—

Pipes laid complete	...	Rs. 28,100
Service Reservoir and filters	...	" 82,978
Connection work	...	" 4,350

Total Rs. 1,15,428

21. The total cost of the works, Rs. 1,15,428, will mean an annual charge of Rs. 5,771 at 5 % interest and sinking fund.

The supervision may be taken at Rs. 100 per month, or Rs. 1,200 per annum.

The maintenance at Rs. 1,000 per annum.

Payment for water to the Mysore Government, as calculated in para 19 Rs. 4,800.

The annual charge would be:—

Interest and sinking fund	...	Rs. 5,771
Mysore Government for water	...	" 4,800
Supervision	...	" 1,200
Maintenance	...	" 1,000

Total Rs. 12,771

The stoppage of Halsur would set at liberty Rs. 10,307 (*vide* page 7 of compilation) in addition to a further sum for stores, other than fuel and for repairs, &c., to the engines.

22. No attempt has been made in the foregoing scheme to underestimate in cost or to cramp the capacity of the works. If a 5" main and service reservoir to contain 200 days' supply were adopted, the first cost would be materially reduced. Filters, too, might be dispensed with, relying upon the domestic filters at present in use. The section of the reservoir wall could also be slightly reduced and still leave a margin for safety and the concrete floor might be only 6" or 9" thick. The Supreme Government will be able, too, to finance the money at less than 5% for interest and sinking fund, and will realize something on the Halsur engines and plant. The scheme could be carried out in 12 months, and the author believes would fully realize its purpose and be for many years equal to its task.

S. T.

May 4, 1888.



## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

**Assam, September 22, 1888.**

Rai Bholanath Dass, Bahadur, Executive Engineer, 1st grade, who was granted an extension of sick leave for five months and twenty-one days, in orders dated 26th June 1888, reported his arrival at Tezpur on the afternoon of the 13th September 1888, and took over charge of the Central Assam Division from Mr. Bolinarayan Borrah, Executive Engineer, 4th grade, temporary rank, on the forenoon of the 14th idem. The unexpired portion of the sick leave, viz., two days, is hereby cancelled.

Mr. Bolinarayan Borrah, Executive Engineer, 4th grade, temporary rank, who was appointed to the temporary executive charge of the Central Assam Division, in orders dated 16th July 1888, during the absence on sick leave of Rai Bholanath Dass, Bahadur, Executive Engineer, made over charge of the said division to the above officer on the forenoon of the 14th September 1888.

**Madras, September 25, 1888.**

The following intimation, received from the Secretary of State, is published:—

Mr. J. F. Somers-Eve, Assistant Engineer, 1st grade, is permitted to return to duty from 22nd August 1888.

Colonel H. M. Vibart, R.E., Superintending Engineer, 5th Circle, is granted special leave for six months from date of relief by Colonel W. H. Burton, R.E.

Mr. W. Hughes, B.A., Executive Engineer, 2nd grade, will assume charge of the 6th Circle from Mr. J. W. Rundall, proceeding on leave, as a temporary measure.

Mr. H. E. Clerk, Executive Engineer, 4th grade, temporary rank, will relieve Mr. Hughes of the Madura Division, and will hold charge of that division in addition to his special work, as a temporary arrangement.

M. R. Ry. S. Gopalakrishna Aiyar, Rai Bahadur, B.C.E., Assistant Engineer, 1st grade, from the 6th Circle, Tanjore Division, to the 3rd Circle, Kurnool Division.

M. R. Ry. R. A. Srinavasa Aiyangar, Rai Sahib, B.A., B.C.E., Assistant Engineer, 2nd grade, passed on the 10th September 1888 the Departmental Standard Examination in Telugu.

**India, September 29, 1888.**

The furlough for twelve months granted to Mr. A. T. Chiodetti, Assistant Engineer, 2nd grade, State Railways, by the Chief Commissioner of Burma, as notified in his Notification, dated 26th August 1887, has been commuted by the Secretary of State into leave on medical certificate for sixteen months.

The Governor-General in Council is pleased to order the following promotions and reversions among the Executive and Assistant Engineers, attached to the several Local Administrations, with effect from the dates specified:—

Dhondoo Sakham Sathaye, Rao Sahib, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 18th May, 1888.

Major H. C. Fox, R.E., from Executive Engineer, 1st grade, sub. *pro tem.*, to Executive Engineer, 1st grade, permanent rank, with effect from 26th May 1888.

Mr. D. Wallace, from Executive Engineer, 2nd grade, to Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 26th May 1888.

Mr. G. S. T. Harris, from Executive Engineer, 2nd grade, sub. *pro tem.*, to Executive Engineer, 2nd grade, permanent rank, with effect from 26th May 1888.

Mr. R. H. Tickell, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from 26th May 1888.

Rajeswar Mittra, Rai Sahib, from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, permanent rank, with effect from 26th May 1888.

Lieutenant E. Houston, R.E., from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, permanent rank, with effect from 26th May 1888.

Mr. B. H. Tickell, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 3rd July 1888.

With reference to Public Works Department Notification, dated the 17th September 1888, the services of the undermentioned Executive and Assistant Engineers attached to State Railways are placed at the disposal of the Government of Bengal:—

Mr. H. B. Addis, Executive Engineer, 1st grade, sub. *pro tem.*

Mr. P. P. Dease, Executive Engineer, 2nd grade.

Mr. H. J. Oddie, Executive Engineer, 3rd grade, sub. *pro tem.*

Mr. A. Bewley, on return from furlough, Assistant Engineer, 1st grade.

Mr. A. Morse, on return from furlough, Assistant Engineer, 1st grade.

Mr. F. J. Pope, on return from furlough, Assistant Engineer, 1st grade.

Babu Siva Datta Pande, Rai Sahib, Assistant Engineer, 1st grade.

Mr. J. Woodside, Assistant Engineer, 2nd grade.

Mr. F. D. Couchman, Assistant Engineer, 2nd grade.

The Governor-General in Council is pleased to order the following temporary promotions to and in the classes of Superintending Engineers, with effect from the dates specified:—

Mr. W. D. Brockman, from Superintending Engineer, 2nd class, to Superintending Engineer, 1st class, with effect from 9th June 1888.

Mr. J. Ramsay, from Superintending Engineer, 3rd class, sub. *pro tem.*, to Superintending Engineer, 2nd class, with effect from 9th June 1888.

Mr. J. R. Bell, from Superintending Engineer, 2nd class, sub. *pro tem.*, to Superintending Engineer, 2nd class, with effect from 27th June, 1888.

Mr. H. F. Storey, from Superintending Engineer, 2nd class, to Superintending Engineer, 1st class, with effect from 10th July 1888.

Mr. J. G. H. Glass, from Superintending Engineer, 3rd class temporary rank, to Superintending Engineer, 2nd class, with effect from 10th August, 1888.

### Military Works Department.

Lieutenant G. A. S. Stone, R.E., Assistant Engineer, 1st grade, is appointed to officiate as Executive Engineer, Barrackpore Division, Military Works, during the absence of Lieutenant Colonel G. D'A. Jackson, Executive Engineer, on privilege leave.

### Director-General of Railways.

With reference to Public Works Department Notification, dated 12th September 1888, the undermentioned officers are transferred, in the interests of the public service, from the Railways noted opposite their names to the Great Western of India Railway Survey:—

Mr. G. F. Lamb, Executive Engineer, 3rd grade, sub. *pro tem.*,—from the North-Western Railway.

Mr. E. H. Tuck, Executive Engineer, 4th grade, temporary rank,—from the Bannu Railway Survey.

**N.-W. P. and Oudh, September 29, 1888.**

### Buildings and Roads Branch.

Major R. R. Pulford, R.E., Executive Engineer, 1st grade, will, on relief by Colonel Swetenham of the charge of the 3rd Circle, Provincial Works, revert to the Public Works Department Secretariat as Personal Assistant to the Chief Engineer and Under-Secretary to this Government in the Public Works Department, Buildings and Roads and Railway Branches.

Mr. J. H. P. Forsyth, Executive Engineer, 4th grade, is, on relief by Major Pulford of the office of Officiating Personal Assistant to the Chief Engineer and Officiating Under-Secretary to Government, Public Works Department, Buildings and Roads Branch, appointed District Engineer, Bareilly, *vice* Mr. R. D. M. Lang.

Mr. R. D. M. Lang, Assistant Engineer, 1st grade, District Engineer, Bareilly, is transferred to the Shahjahanpur district as District Engineer.

**Central Provinces, September 29, 1888.**

Mr. R. B. Thomson, Executive Engineer, 2nd grade, Jabulpore Division, is granted one year's furlough (with permission to extend for any period not exceeding two years) with effect from the 1st October 1888, or such subsequent date as he may avail himself of the same.

**Bengal, October 3, 1888.**

### Establishment—General.

Mr. W. D. Bruce, Executive Engineer, has been granted by Her Majesty's Secretary of State for India an extension of four months' furlough.

### Irrigation Branch.

Mr. O. C. Lees, Executive Engineer, has been granted by Her Majesty's Secretary of State for India an extension of four days' furlough.

## Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Revenue and Agricultural Department:—

**The 22nd September 1888.**

**113 of '88.**—Robert Archibald White, of Eagle Chambers, King William Street, Adelaide, in the Province of South Australia, Engineer.—*For improved appliances for effecting the change of gauge of Railway Vehicles.*

**121 of '88.**—Loftus Perkins, of 6, Seaford Street, Gray's Inn Road, in the County of Middlesex, England, Engineer.—*For improvements in refrigerating and freezing Apparatus.*

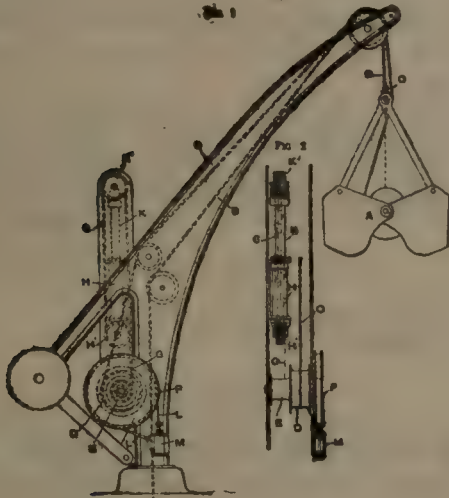
**126 of '88.**—Rupert Scheffner, Manufacturer, of Dresden in the Kingdom of Saxony and German Empire.—*For improvements in electric arc lamps.*



- 133 of '88.—George Lansell, of Fortuna Crushing Works, Sandhurst, in the Colony of Victoria, Quartz Miner.—For improvements in apparatus for equalizing the strain on winding gears such as are used in mining shafts and warehouse lifts.
- 144 of '88.—Jacques Jules Couchemann of the firm of Couchemann and Co., of No. 9, rue Lónnican, Paris, in the Republic of France, Mechanician.—For an improved motive power machine.
- 150 of '88.—Thomas William Watson, of St. Arnand, in the Colony of Victoria, Engineer, and Thomas Denny, of 93, Chapel Street, South Yarra, in the said Colony, Mining Engineer.—For improvements in combined grinding, classifying and amalgamating machines.

RECENT BRITISH PATENTS.

CRANES FOR WORKING GRAB BUCKETS.—*W. Shapton, London.*—The inventor here introduces an improved form of auxiliary tackle for delivering the material from the bucket. The main chain is allowed to become slack, and the weight of the bucket on the auxiliary chain has the effect of opening the bucket. The bucket A is raised and lowered by the chain B in any ordinary manner. C is the auxiliary rope or chain, which passes over the head of the jib and is wound upon the drum D. The axis of D carries two other drums E and F; the rope G is wound round E, and passes round the pulleys H<sup>1</sup> K<sup>1</sup>



upon the hydraulic cylinder H and ram K. The drum F acts as a brake; the strap L passes round it, one of its ends being fixed to the cylinder M and the other to the piston rod. The area of this piston on the side furthest from the rod is greater than that of the other side. Normally the strap is kept slack and the water is admitted to both ends of the cylinder; the brake is brought into operation by the water being allowed to escape from the larger side of the piston. When the grab is being lowered by the chain B the rope C is unwound from the drum D, the rope G is wound upon the drum E, and the ram K is forced into the cylinder H against the pressure of water. The reverse operations take place when the grab is raised. In order to deliver the bucket of its contents, water is admitted to the piston rod end of the cylinder M, and the pressure causes the brake strap to tighten round its drum. The chain B is then allowed to become slack, so that the grab is suspended by the rope C and the delivery takes place. Four claims are made for this arrangement of working the auxiliary rope as described.—No. 8550. June 14th, 1887.

Advertisements.

NOW READY.

TO ENGINEERS AND ESTIMATORS.

DIAGRAMS OF

Scantlings, Rolled Iron Beams, Water Velocities

FOR ENGINEERS AND ESTIMATORS,

BY J. E. HILTON, MEM. INST. C.E.

A handy book with Litho-diagrams for estimating and designing rapidly.

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LAHORE.

P. W. D.

CHITTAGONG DIVISION.

Tenders are invited for supply of doors and windows noted below. The Executive Engineer does not bind himself to accept the lowest or any tender.

NAME OF WORK.	Tender to be in Form No.	Amount of earnest money to accompany each tender.	Date and hour of opening tenders.	Date of commencement of work.	Date of completion of work.	Deposit money required to be paid by the successful tenderer	REMARKS.
Supplying Doors and Windows for the new Courts on Fairy Hill, Chittagong.	P. W. D. Form No. 14 M.	vide rates printed on the back of the form quoted above.	12 o'clock Saturday 6th October 1888.	On receipt of acceptance of Tender.	15th February 1889.	Rs. 10 per cent. on the Total value.	Three sheets of plans and specifications can be seen— At the office of the Executive Engineer, 1st Calcutta Division; At the office of the Executive Engineer, Dacca Division; At the Head office of the Chittagong Division (Chittagong); Special attention is drawn to Clause VI. of the specification.

F. SILLS, C.E.,  
EXECUTIVE ENGINEER,  
Chittagong Division.

CHITTAGONG; }  
The 10th September 1888.



**ROOMS WITH BOARD,**

BY DAY OR MONTH.

**Mrs. OGILVIE,**

46, WELLESLEY STREET,

CORNER OF PARK STREET,

CALCUTTA.

**A**N Engineer, 18 years' experience on Canal and Railway Construction—the last 6 of which he has been engaged on one of the largest Bridges in India—will be disengaged about the 15th September. Highest references and Testimonials.

Address—ENGINEER,

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Dehree on-Sone.

(192)

**Notice.**

TO CONTRACTORS AND OTHERS.

For sale at the S. M. Railway Company Stores at Hubli.

10 Portable Engines, 10 H.-P.

2 Portable Engines, 12 H.-P.

Also the following Centrifugal and Contractors' Pumps:—

5 eight-inch Centrifugal Pumps, "invincible."

4 seven-inch Centrifugal Pumps, "invincible."

16 six-inch Centrifugal Pumps, "Invincible."

4 four-inch Contractors' Pumps.

7 six inch Contractors' Pumps.

1 six-and-a-half-inch Contractors' Pump.

1 eight-and-a-quarter-inch Contractors' Pump.

1 two-and-a-half-inch Contractors' Pump.

The Portable Engines and Pumps have all been in use, but they will be put into working order before being sent away.

The Agent and Chief Engineer, S. M. Railway, Dharwar, is prepared to receive offers for any of the above.

They are open to inspection to any one wanting them.

Apply to AGENT and CHIEF ENGINEER.

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S. M. Railway, Dharwar.

**CREAT WESTERN HOTEL,**

[29]

BOMBAY.

MACHINERY

CYLINDER  
ENGINE

OIL

SPINDLE

BATCHING

LUBRICATING

Stocks of all descriptions always in hand. Contracts at reduced rates.

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**HIGHLAND WHISKY.**

Rs. 25 per dozen.

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40, STRAND.

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HARDWARE AND METAL MERCHANTS.

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Regulus of Antimony, Pure Block Tin.

Pig and Sheet Lead, Muntz Metal Rods and Sheets.

Brass and Copper Rods, Tubes and Sheets.

Zinc Sheets and Tin Plates.

Best Tool and Miners' Steel.

Spring Steel selected, and mild Steel Sheets.

Lowmoor, Farnley, and best Staffordshire Bar and Sheet Iron.

Plain, Galvanized, and Corrugated Iron Sheets, Ridging and Gutterings.

Wrought Iron Tubes and Fittings for Gas and Water.

Lap-Welded Boiler Tubes.

Cast Iron Pipes with turned and bored spigot and socket joints and coated.

Rain Water Pipes and Connections.

High Conductivity Copper Tape Lightning Conductors.

(36)

**Rolled Iron Joists and Girders.****Wanted for Mussoorie Municipal Board.**

NOTICE.

**W**ANTED a SECRETARY and OVERSEER for the Mussoorie Municipality. Monthly salary Rs. 200, House allowance, Rs. 30, Horse allowance, Rs. 20.

The qualifications necessary are competency in business matters generally, ability to speak Hindustani fluently, activity, good health, and steadiness, with a fair knowledge of surveying and ordinary engineering.

Applications with certificates of character, and medical certificate of physical fitness, with statement of age, to be addressed to the CHAIRMAN, Municipal Office, Mussoorie, where they must be delivered on or before 30th October 1888.

**NOTICE.**

**W**ANTED a District Engineer for the District Board of Chittagong, on a salary of Rs. 200, rising by Rs. 25 annual increment to Rs. 300 per month for approved work, with fixed daily allowance, Rs. 4 per diem, and mileage at the rates for a second class officer when out on duty. Candidates must possess qualification as prescribed by Government and published in the *Calcutta Gazette* of the 16th March 1887, IB, page 79.

Applications, with copies of testimonials and medical certificates of fitness for out-door duties, should be submitted to the undersigned before 30th November next, as prescribed in Rule 11 of the part quoted.

A. MANSON,

CHAIRMAN,

District Board.

CHITTAGONG, DISTRICT BOARD'S OFFICE; }  
September 1888.**WANTED.**

**T**HE Municipality of Sukkur, require an Engineer to supervise Drainage works costing Rs. 70,000

None without experience need apply.

The engagement will commence at once and will not exceed six months in duration.

J. G. SINGLE,

M. INST. C. E.,

Chairman, Drainage Committee,

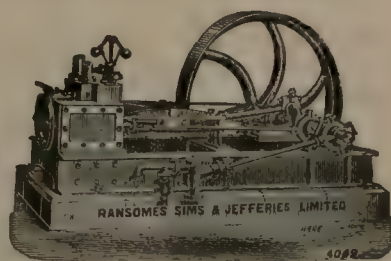
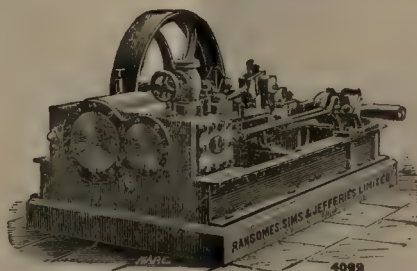
S. M. C.

SUKKUR; September 14th 1888.



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ENGINES and BOILERS—Portable, Vertical, Semi-Fixed and Stationary.



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These wheels are Noiseless and self-lubricating, do not drop oil or allow the  
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Vertical or Horizontal wheels, and run perfectly for years without attention.

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PATENT SUGARCANE MILLS.  
For particulars of Depots, Licensees, &c., address—  
THOMSON & MYLNE,  
BEHEEA, E. I. RAILWAY;  
or 6, Commercial Buildings, Calcutta.

(103)

### BEST MIRZAPUR STONE.

The Mirzapur Stone and Trading Co., Cut-Stone Contractors and Quarrymen  
Mirzapur, can supply—

Flagging .. .. .	Roofing.
Pillar Bases .. .. .	Coping.

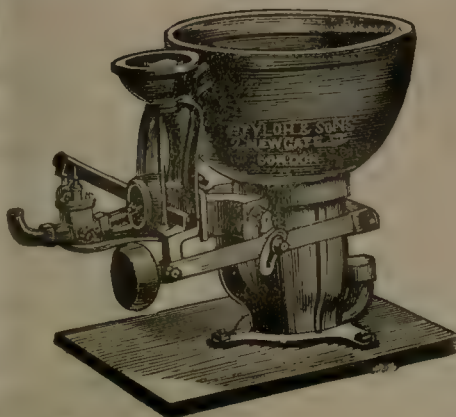
And all descriptions of Cut-Stone. The cheapest in the market.  
Apply to the Company or to

LYALL, MARSHALL & CO.,  
4, Clive Ghat Street, CALCUTTA.

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Depôt—Sulkea, Calcutta.

### Calcutta Plumbing & Gas Fitting Establishment.



Materials of all  
sorts for the  
above always  
in stock. Trade  
supplied on  
the usual  
terms.

J. D. JONES,  
Mechanical Engineer,  
PROPRIETOR.

(108)



## BURRAKUR IRON WORKS, BURRAKUR, BENGAL.

Cast-iron Socket Pipes, of ordinary dimensions, coated with Dr. Angus Smith's solution, and tested up to a pressure of 250 feet of water	Rs. 4-4 per cwt.
Cast-iron Flange Pipes, of ordinary dimensions, tested up to a pressure of 250 feet of water, with faced joints and drilled bolt holes, coated with Dr. Angus Smith's solution	" 5-12 "
Cast-iron Bends, Tees and Cross Pieces for Pipings of ordinary dimensions coated with Dr. Angus Smith's solution from	" 7-0 " upwards.
Cast-iron Fire-bars, Floor-plates, Plain Columns, &c., from	" 5-0 " "
Cast-iron Railway Chairs and Railway Sleepers from	" 3-8 " "
Cast-iron Ornamental Columns, railings, gates, spiral staircases, porticos, brackets, arch-fillings, &c., in great variety	At cheapest rates.
Cast-iron Rammers, Road Rollers Garden Rollers, Sugarcane Rollers, Rain-water Pipes, Axle-boxes, parts of machinery and other castings of any description	At cheapest rates.
Water-lifts ... from Rs. 35-0 each, and upwards.	Foundry Pig Iron No. 1 ... " 45-0 per ton.
Ploughs ... Rs. 4-0 each.	Ditto No. 2 ... " 42-8 "
	Ditto No. 3 ... " 40-0 "

Remarks.—Special quotations for large orders. Designs of Ornamental Castings of any description can be had on application.

Orders to be addressed to the SUPERINTENDENT from whom any further particulars can be ascertained.

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## THE INDIA RUBBER, GUTTA PERCHA, & TELEGRAPH WORKS Co., Ltd.,

ELECTRICIANS, ENGINEERS AND CONTRACTORS,  
MANUFACTURERS OF

### ELECTRIC LIGHT APPARATUS,

DYNAMOS, LAMPS, CARBONS, LEADS, SWITCHES, VOLT AND AMPERE METERS, LEAD COVERED LEADS FOR UNDERGROUND WORK  
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GODOWNS:—DACRE'S LANE.

(168)

Telegraphic Address—"SILVERGRAY," CALCUTTA.

## COMMERCIAL UNION ASSURANCE CO., LD.

*Extracts from the Twenty-sixth Annual Report viz. for the year 1887.*

### FIRE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£769,265 0 0
Interest ...	£ 19,612 0 0
Losses after deducting Re-insurances ...	£448,587 0 0

### LIFE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£125,559 0 0
Interest and Dividends ...	£ 45,649 0 0
Claims less Re-insurances, ...	£ 79,229 0 0

### MARINE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£175,118 0 0
Interest ...	£ 8,294 0 0
Losses after deducting Re-insurances ...	£138,365 0 0
Interest not belonging to above, but included in Profit and Loss ...	£ 18,545 0 0

The Life Fund was increased during the year by £65,648 and now amounts to £1,070,064.

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the uncalled Capital of £2,250,000.

The rates of Premium are moderate, but they are not unsafely low, and will be found to stand the test of time, thereby in conjunction with the ample Funds affording absolute security to the assured.

The Total Funds and property in hand on 31st December 1887 stood at £2,613,059.

(39)

C. H. OGBOURNE, *Manager and Underwriter.*

## PURE HYDRAULIC LIME.

FREE FROM ADULTERATION.

Numerous favourable certificates of the quality of our manufacture have been received, and the following are fair selections:—

J. H. APJOHN, Esq., Superintending Engineer, Kidderpore Dock Works, says:—

"Mr. McKennie's test for purity applied at Raneegunge shewed that it contained only 22 per cent. of insoluble matter, or only 3rds of the impurity allowed; there can be no question but that it is of very superior quality."

PAUL DEJOUX, Esq., Executive Engineer, Government Cement Experiment Division, reported:—

"It is the best Ghooting Lime imported into Calcutta."

JAMES KIMBER, Esq., M.I.C.E., Engineer to the Corporation of Calcutta, says:—

"It has been for long past and is now invariably used in all works, particularly drainage works. I have much pleasure in certifying to the excellent and reliable quality of the Lime."

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# INDIAN ENGINEERING.

SATURDAY, OCTOBER 13, 1888.

## BY THEIR FRUITS YE SHALL KNOW THEM.

THERE is, perhaps, no country in the world where hobby riding is carried to such perfection, as in India. To-day it is the education of the "masses," to-morrow it is the "emancipation of the people," the next day it is the "reconstitution of the Legislative Council", and so forth. But the hobby to which agitators have clung with some shew of pertinacity is "technical education." In one of our late issues we quoted Dr. Mahendra Lall Sircar, to show that the country was not ripe for it, and that much greater advancement must be made in scientific knowledge before technical education could be of any use to its recipients. It may be said that the worthy Doctor was dogmatising, and that a practical test must decide the question one way or the other. To those who hold this view we would point to the state of the Madras College of Engineering, and ask, why should the results be what they are if all this rage for technical learning is a genuine and spontaneous outcome of popular aspiration. It should be one of the most popular institutions in the Southern Presidency, but on the contrary, it is, we believe, the only one which is not patronized by students. It cannot be said that its past history is a blank, for we could point to several men out of it who to this day have held stations of trust and responsibility of which any man would be proud.

Notwithstanding such traditions there are signs of decadence that is very disappointing, and the question that naturally suggests itself to one is, is it any longer necessary to keep up a costly machinery for turning out subordinates in the Public Works Department? is the game worth the candle? The following facts culled from the letter of the Acting Principal of the College to the Director of Public Instruction speak for themselves. During the past year there were on the roll of that institution 117 students, against 166 in 1886. This falling off "is accounted for by the fact, that during the year the old and new rules overlapped, and students completed their courses and left the College under both sets of rules; thus in May a class of Engineer Subordinates, 34 in number; a class of Draftsmen, 22 in number; and a class of Surveyors, 21 in number, passed out under the old rules, and in December Draftsmen and Surveyors to the number of 17 and 8, respectively, completed their courses under the new rules and left the College; this makes a total of 102 students who left during the year. In 1887, 32 students in all joined the College under the new rules, some of whom subsequently left. This paucity in admission is said to be due "to the late extensive reduction in the Public Works Department, and the consequent difficulty students have in getting employment, to the raising of the standard, which deters many students from joining, as they fear they may after all fail to qualify to certificate, and to the extension of the periods of study and enhancement of the fees."



The rules of the College have also lent a helping hand in bringing about this undesirable state of affairs, for it is ordained that if a student on leaving the College fails to qualify for a certificate he will be refused a certificate even if he succeeds in passing a subsequent examination. We fear the first reason assigned has principally acted as a deterrent. As we have said on previous occasions, the system of education in our schools and colleges is defective in the extreme. We have taught the rising generation that the end and aim of the training students receive is to qualify them for public service, and if there is no outlet in that direction for their labor, all that labor is thrown away. This injudicious advice strikes at the root of self-help and incapacitates them from any manly application to study. Instead of encouraging them to habits of self-reliance, such a spirit is sedulously crushed out of them, by pointing out that the Government service is the Alpha and Omega of their existence; and, is it, therefore, a matter of surprise that sullen discontent should take the place of cheerful labor when their ambition rises no higher than coveting a Government post.

Under the orders of the Secretary of State the College has been re-organised, the members of the former staff have been retained, but under different designations, and the new scale has been completed by the arrival of two thoroughly qualified professors from England. It is unsatisfactory to read that in the Draftsmen's classes out of 17 students only one passed, whilst in the Surveyors' classes in the first division there were eight students examined, out of whom only two passed for third-class certificates, the others all failed. This might have, in other circumstances, been regarded as a passing incident not calling for special notice, but when read by the light of what the Principal himself expresses on the method of teaching as followed in the College, is of such importance as to be considered seriously. He says that the Draftsmen's classes were taught by Mr. Pope who had got into a groove and could hardly be persuaded to get out of it, and adds, "the students in the Draftsmen's and Surveyors' classes are as a rule deficient in general intelligence, and it is very difficult to get them to think for themselves . . . they did not at all take kindly to the new subjects and had apparently convinced themselves that the examination would be as easy as it used to be." But this is not all; the candid confession of the Principal in regard to the materials at his disposal is ominous. He remarks:—"The general average of intelligence in entering the College is decidedly low, and, until we get a better stamp of students we cannot expect any great improvement." That this is self-condemnatory no one will dispute. What then is the use of the re-organization which has been heralded with such a flourish of trumpets.

Let us now turn to the opinion of the Director of Public Instruction and see what he has to say on the subject and on the explanation offered by the Principal of the College. He is inclined to believe "that the re-organization of the institution will mark a new era in its history and that with its extended scope and improved methods

of operation, it will yet play an important part in the promotion of technical education in general and Engineering in particular." All this sounds very well on paper, but when practically considered there are a few trifling hitches which should not be lost sight of. The Director is unhappy in his advice to those who hold the reins of local self-government. He says:—"Until, however, the State compels local and Municipal bodies to employ only technically qualified Engineering subordinates, the usefulness of the institution must be limited, and its cost to the exchequer be much greater than would otherwise be the case." We regret having exceeded the limits we had prescribed for this article, but when such a fallacy is published in a Government Resolution it would be a dereliction of our duty as a journalist to permit it to pass unnoticed. In the first place freedom of action is to be restricted. The elementary principles of political economy teach us that an employer of labor will, as a matter of course, go to the cheapest market for his requirements. If he could secure the services of an Engineer not brought up in a Government College, but who is nevertheless capable of discharging his duties satisfactorily, is he under any obligation to forego this advantage and indent on the Government College? Secondly, is there a sufficient number of these technically qualified Engineers to take up all these appointments? The local Boards are, at all events, supposed to be alive to their own interests, and if they can see their way to the employment of the alumni of our Colleges, they will not wait for the advice of interested parties. The order of the Government of Madras is short and to the point:—"The scheme of re-organization of the College must be given a fair trial before a final decision with regard to its effect can be arrived at, but the results are so far not encouraging."

#### AMERICAN LOCOMOTIVES AND CARS.

WE wrote, not long ago, in commendation of the American style of illustrating magazine literature. Honesty impels us to a repetition of that praise today, with regard to an Article in the August issue of *Scribner* dealing with American locomotives and cars. There is in it, *inter alia*, pictured presentment of a New York Engine "Round House," which in its apparently unstudied, yet palpably well studied effects of light and shade, in its clear verisimilitude and naturalness, ought to put to utter shame such daubers as Sir Richard Temple, and men of his sensational ilk, who appear to take no shame to themselves in foisting on the publishing world such outrageous caricatures of scenery in chromo-lithograph guise, as were not long ago presented to the world by the author of *Palestine Revisited*. The American method of art presentment is strikingly different, characterized throughout by unpretentiousness, thoroughness, and an absence of self-seeking, well worthy of note and regard in days like these we are living in, wherein amongst the heedless and unthoughtful, presumption is only too willing and apt to usurp the place of real worth.



But to our proper subjects—American locomotives and cars to wit, and glimpses into their history. Towards the end of the year 1827, it seems, the Delaware and Hudson Canal Company put the Carbondale Railroad under construction. It extends from the head of the Delaware and Hudson Canal at Honesdale in Pennsylvania to coal mines belonging to the aforementioned Company at Carbondale. It was a very incipient attempt. The first railroad undertaken in America on a really comprehensive and satisfying scale, was the Baltimore and Ohio. Its construction was begun in 1828, and in 1830 there were over 1,000 miles of Railway track in use in the United States.

It is matter for wonderment now-a-days that for long years it seemed to Americans, worthy subject for argument whether the motive power to be used on their newly improvised iron roads should be, most appropriately, steam or horse haulage. Finally there came to the country, reports of the celebrated trial of locomotives made in England, on the Liverpool and Manchester Railway in 1829. During that same year Mr. Horatio Allen had gone to England with the view to learning there all that it was possible to learn about steam locomotion. The gist of his Report thereon reposed "on the broad ground that in the future there was no reason to expect any material improvement in the breed of horses, while, in his judgment, the man was not living who knew what the breed of locomotives was to place at command."

In early, undeveloped days of Railway construction in America, flues for engine boilers were often manufactured out of disused gun barrels. After that who will feel inclined to exalt himself exorbitantly on having converted bayonets into reaping hooks, swords into sickles? America is very ingenious, conspicuously go-ahead; but it cannot go on its own feet without teaching, preaching, exemplar. *Apropos*, here is a quotation from an "Early History of Locomotives in this Country," an American publication which says:—These locomotives, which were imported from England, doubtless to a very considerable extent, furnished the types and patterns from which those which were afterward built here were fashioned. But American designs very soon began to depart from their British prototypes, and a process of adaptation to the existing conditions of the railroads in this country followed, which afterward "differentiated" the American locomotives more and more from those built in Great Britain. A marked feature of difference between American and English locomotives has been the use of a "truck" under the former. *Cui bono?* Primitive locomotives in America never had more than four wheels; and they sufficed to cling to the track. Now-a-days it is considered a triumph of ingenuity to tack on to an engine as many inutile wheels as room can possibly be made for.

Improvements in steel manufacturing processes, resulting in preference of that material for rails and tires have made it possible for modern Railway lines to carry double the weight they were able to undertake when iron was in vogue for the purpose indicated. *Apropos*, this

seems to us a remark worthy of consideration by people concerned in Railway politics and amendments. Of late years urban and suburban traffic has created a demand for a class of locomotives especially adapted to that kind of service. One of the conditions of that traffic is that trains must stop and start often, and therefore, "make fast time," it is essential to start quickly. Few persons realize the great amount of force which must be exerted to start any object suddenly. For this reason trains which start and stop often, require engines with a great deal of weight on the driving wheels—but, we are digressing, and have already exceeded the space prescribed for our article.

#### THE ARCHÆOLOGICAL SURVEY OF INDIA.

WE have been impelled by the observations of one of our correspondents in a late issue to go into the progress report of the Madras branch of the Archæological Survey for February and March last. We find that Mr. Rea's party, consisting of himself and 5 draftsmen, turned out among them 18 drawings in the two months; 45 inscriptions in addition appear to have been copied from 11 different places, and 7 photographs appear to have been taken, besides making various excavations. The 18 drawings have apparently all been made by the draftsmen; of these five appear to be drawings of sculpture, and which might, we believe, have well been executed with mechanical accuracy by photography, and one whose title of "*sight plan*" fairly puzzles us, may for the present be left out, leaving 12 drawings which would absolutely need correct measurement, as the outturn of the party. This number does not strike us as excessive, but it probably is a fair outturn for the party. The method of expressing the scales is unusual, it is our impression that a scale of one-tenth, or one-twentieth, continues to remain a scale of one-tenth or one-twentieth, whether it be in feet, in inches, or in miles; and unless the meaning intended to be conveyed be, that the scale, is a scale of one-tenth or one-twentieth of a foot to the inch, or to the foot, or to some other definite unit unnamed, the addition of the word feet to the scale is unmeaning, and liable to give rise to misconception of the real scale intended.

We are, however, more puzzled by the detail of the inscriptions; surely it is not meant to be stated, taking No. 272 as an example, that there are really 14 letters in each of the 35 lines, neither more nor less! And how have the double and triple combinations of letters so common in Indian writing been reckoned? Have the vowel marks been reckoned as letters? If the numbers of letters stated per line be merely averages, we fail to perceive the necessity of their being counted at all. As a criterion for the unerring identification of the inscriptions, the laborious counting of the letters and then striking an average is perfectly worthless; much more to the purpose would it have been, if Mr. Rea had relieved himself of this useless and assuredly very tedious labor, to give us instead the class of stone (sandstone, granite,



marble or other) on which the inscriptions have been cut; it must have been no light task for him to have counted the five to six thousand crabbéd alphabets in the 800 lines, which roughly is the aggregate of the 45 inscriptions; and we are surprised that in view of the tedious nature of the work, and its absolute worthlessness for any conceivably useful purpose, that this reprehensibly useless frittering away of the time and energy of an officer, who, so far as outsiders may judge in the absence of the drawings, seems to have devoted himself to his work with fair assiduity on the whole, has not been stopped by a hint from the Director-General of the Survey, to whom this list and similar previous lists have been submitted.

We would, if we could, avoid criticising unfavorably the report of an officer who appears to have devoted himself fairly assiduously to his work; even although we perceive that he has not made a single drawing himself, notwithstanding that he had before him the example of no less an authority than the late Director-General of the Archaeological Survey in whose 22 published volumes every single one of the drawings aggregating a thousand, more or less, purport to have been made (and our inquiries confirm the evidence of the plates) by himself or his assistants personally, and not by draftsmen; indeed, we find the North of India Survey had no draftsmen at all during the 16 years or so of Sir Alexander Cunningham's incumbency: but perhaps it is as great an accomplishment, perhaps a greater, to get the requisite work done by inferior instruments as by one's own personal hands. Our more serious complaint, however, rests on other grounds; Mr. Rea gives us in his report no indication of even the approximate age of the ruins he describes; they may be of yesterday for aught we can learn to the contrary from his report, or they may be pre-Christian: it is evident that the interest and importance of the remains described depend all but wholly on their age. The report is besides, in great part, unintelligible. Mr. Rea is unhappily not felicitous in his diction; we have tried in vain to make anything at all of most of his descriptions; and, generally, there is an ingenuity unconsciously displayed by Mr. Rea in rendering his report absolutely useless for any purpose whatever, except it be to display his own inability to cope with the subject.

THE Engineering preliminary studies for the construction of the Congo railway line are nearly terminated. The line, which is to run from Matadi to Stanley Pool, will have a length of 350 kilometres, 75 centimetres gauge, and commence at seven metres above the level of the sea, rising gradually to 60 metres.

THE German Colonial Company have passed a resolution to put forward German stations in East Africa as far as the lakes, including both the Victoria and Albert Nyanza. It seems that the *Times* has been a little premature in announcing that our position in that part of the world shuts out other communications with Emin Pasha. There will be a race to open up that part of the Dark Continent, and the question of who will win will involve a good many national characteristics. Hitherto we have had few Colonial rivals for many years. We have now to see which is better, the German system or our own.

## Notes and Comments.

**A BOMBAY ARTS EXHIBITION.**—A project is under consideration to hold an Arts Exhibition in Bombay next February.

**ANOTHER TRANSFER.**—We learn that Mr. Von Ahn, Executive Engineer, on return from furlough, will be transferred to Burma.

**MYSORE WATER-SUPPLY.**—We learn that the Mysore Water-works were opened to the public on the 10th instant with 103 fountains for distribution.

**RANGOON DRAINAGE SCHEME.**—Mr. Ault, of Shone and Ault, is now at Rangoon, superintending his contract works for the drainage of the town of Rangoon.

**NATIVE ARTS EXHIBITION.**—The Poona Native Arts Exhibition, which is expected to be the grandest of the kind ever held in the Bombay Presidency, will be opened on the 6th proximo by the Governor.

**RAILWAY CONSULTING ENGINEER CHANGES.**—Colonel Jopp has been ordered to join at Madras as Senior Deputy Consulting Engineer for Railways. Major Coaker leaves Madras for Lahore to be Deputy Manager of the N.-W. Railway.

**A NEW EXTENSION.**—Thawatti and Pyinmana section of the Toungoo-Mandalay Railway was opened for passenger traffic on 26th September, after it had been inspected by Colonel W. G. Cumming, R.E., the Chief Engineer of Burma.

**BURMA HARBOUR DEFENCES.**—We learn that a Special Defences Division, with head-quarters at Rangoon, has been formed, and that Lieutenant W. R. Morton, R.E., has been placed in charge of it, and will be under the orders of the Superintending Engineer, 1st Circle, Burma.

**MR. W. H. RUSHTON.**—We learn that this officer has reported his return to Bengal from Biluchistan, but regret to hear that the excessive heat and glare of those parts have injured his eyes: we hope, however, that his appointment to Darjeeling will afford him permanent relief.

**COUPER PAPER MILLS.**—The Couper Mills of Lucknow appear to be making very steady progress. The results for the half-year ended 30th June 1888 must be regarded as evidence of satisfactory working, and go to shew that there is a promising future for paper manufacture in Upper India.

**PUNJAB UNIVERSITY.**—At a Meeting of the Senate of the Punjab University, held on the 23rd July 1888, it was resolved that Rai Bahadur Ganga Ram, A.M.I.C.E., M.I.M.E., Executive Engineer, be appointed Examiner in Engineering for 1888. This was accepted unanimously.

**A GOOD APPOINTMENT.**—Major General Palmer, of the Royal Engineers, has been appointed Consulting Engineer to the Government of Japan. General Palmer has been long connected with both China and Japan, and his name is associated with some important projects already carried out in those countries.

**A NEW RAILWAY COUPLING.**—We learn that Mr. G. E. Moore, Deputy Consulting Engineer, who recently patented a convenient form of sleeper, has now turned his attention to railway coupling and has devised an automatic locking and tightening arrangement which promises to be *just the thing wanted*.

**THE EQUITABLE COAL COMPANY'S MANAGERSHIP.**—We have been asked to contradict the statement which



we recently made relative to a change in the managership of this concern in February next. We believe that the present *régime* will continue until another *contrétemps* like that of July last occurs again!

**RANIGANJ FIRE-BRICKS.**—While Calcutta is meeting its wants in the matter of fire-bricks by importations from the old country, Singapore is indenting largely on India for the Raniganj manufactured article. This latter demand is advancing largely with the growth of mining and other industrial enterprises in Malaya.

**SINGARENI COAL.**—According to Mr. Berkley, Locomotive Superintendent of N. G. S. R., the evaporative power of this coal is 6·36, that is to say, 1lb. of coal will evaporate 6·36lbs. of water. The experiments on the Madras Railway, with other Central Indian coals, gave the following results:—Narbuda, 5·6lbs.; Minaria, 5·1lb.; and Warora, 4·9lbs.

**INDIAN STATION-MASTERS TRANSFERRED TO BURMA.**—These men have been transferred on the same salary that they received in India, and it is hard to expect them to work in a more expensive province for the same rate of wages as in India. It is hoped they will be either promoted to a higher grade, or allowed a local allowance like the Engineer and Subordinate Establishments of the P. W. D. in Burma.

**MADRAS DIAMOND FIELDS.**—We are glad to learn that the Madras Presidency Diamond Fields Company has added 225 packages of diamond mining and washing machinery, value Rs. 20,000, ex *Navarino*, which completes all its present requirements. Despite the gloomy forebodings of "croakers" we again iterate the opinion already expressed in these pages that there is a bright and prosperous future in store for the Company.

**A SCHOOL OF ENGINEERING FOR CEYLON.**—Our island neighbours, who have, to some extent, been meeting the Engineering and Surveying needs of the Eastern Settlements for some years, *now* feel the want of a School of Engineering for the Colony. Ceylon possesses trained officers in the Public Works Department whose services could be utilized as lecturers, while there is the Government Factory available for the practical part of the training.

**AN ACKNOWLEDGMENT.**—We have been favored with Selections from the Records of the Government of India in the P. W. D., No. CCXLVI., being Papers relating to the Oyster Reef Light House. Colonel Lang's Note is the most valuable portion of the Pamphlet. It contains sketches and brief descriptions of some types of light-houses—both of masonry and iron—studied in connection with the case. Should space permit, we may deal with this subject in a future issue.

**PROCEEDINGS UNDER THE INVENTIONS AND DESIGNS ACT.**—The Government of India, in the Home Department, notifies that applications for leave to file specifications of inventions, or for orders for the registration of designs and all correspondence relating to proceedings under the Inventions and Designs Act, 1888, should be addressed to the office of the Secretary to the Government of India in the Revenue and Agricultural Department at Calcutta and not to his office at Simla.

**NO MORE SPECIAL LEAVE.**—Owing to a redundant P. W. Establishment, it became necessary this year for Government to allow some of its surplus Engineers to take special leave on half pay, such leave counting as service towards pension and to be limited to two years. A considerable number of men availed themselves of these advantageous terms; but further applications are now

being rejected, as Government finds that it wants all the Engineers it has got for works in progress.

**THE PUBLIC SERVICE COMMISSION REPORT.**—The *Indian Daily News* thinks that it might be as well to publish the Government of India despatch, and permit of a free expression of public opinion on the Public Service Commission Report in India upon the Government's proposals, before the Home authorities decide which are, and which are not, to be given effect to. We take the initiative in this matter and publish the views of the Madras Government on the subject of the Public Works Department.

**INTER-WORKING OF THE BENGAL-NAGPUR AND E. I. RAILWAYS.**—When the Bengal-Nagpur Railway is completed and through traffic established, it will be found, we fear, that the accommodation at Asansol and Howrah and the hauling power of the E. I. R., are inadequate for the extensive traffic which would ensue in consequence of the inter-working of the two Railways. It is suggested that the Bengal-Nagpur Railway should be on the alert; and before matters assume a threatening attitude should have an independent communication with Howrah through Midnapore.

**THE KIDDERPORE DOCKS.**—There has evidently been some bungling in this connection, when we are told that the original estimate—Rs. 2,33,30,105—by Mr. Duff Bruce has already been considerably exceeded, and it is only a question of time to be told that a similar sum will be required to complete the project and its approaches. A correspondent pertinently enquires, why these works should have been undertaken at a time when the Indian exchequer was in an insolvent condition, and before it was carefully ascertained that the cost estimated would not be exceeded?

**A NEW DEPARTURE AT MADRAS.**—A class for instruction of Sub-Overseers and Maistries will be formed in January 1889, at the Madras College of Engineering. The course of instruction will last one year; no term fees will be levied and no examination need be passed. At the end of the course a certificate of attendance will be given. The class will at present be limited to fifteen in number. Instruction will be given in the vernaculars. Selection will be made from the sons of artisans or maistries, or from youths who have already had practical training in some of the building trades.

**TRIALS WITH A DYNAMOMETER.**—Mr. J. Wallace, C.E., of Bombay writes:—I am making the final trials with a new Dynamometer which makes a continuous diagram of the resistance of any machine from 0 to 14 H.-P. for use in mills. The enclosed card is a sample of the diagram. All the machinery seems to run in pulsations, and I am trying to find to what extent the joints of the belts account for this peculiarity. The instrument is small, portable and easily handled. I propose to send you the first details, as soon as I am satisfied with every part of the apparatus.

**A FITTING COMPLIMENT.**—At the dinner given by the Delegates to the recent Railway Conference to its President, Colonel Conway-Gordon, the latter said, in replying to the toast coupled with his name:—At our next Conference we shall miss the familiar face of Sir Guilford Molesworth. We all, both Guaranteed and State, can appreciate how much is due to Sir Guilford Molesworth for the skilful and scientific way in which he has piloted the Government of India through every difficulty that has been experienced in the development of the Railway system in India." (Applause.)



**THE RUBY MINES—AGAIN!**—A contemporary learns from England that negotiations between the Secretary of State and the Streeter-Rothschild Syndicate regarding the leasing of the Burma Ruby Mines are likely to terminate satisfactorily in a very short time. The lease will probably be granted either for five years at four lakhs per annum (the terms of the original tender) or for seven years at an annual rental of six lakhs. The native rights question has been thoroughly thrashed out by Sir Charles Crosthwaite, and a *modus vivendi* can, it is believed, be established between the lessees and the Mogok miners.

**RAILWAY ACCIDENT AT MONGHYR.**—On the 27th ultimo an accident occurred on the Monghyr Branch Railway. The train which leaves Monghyr for Jamalpore at 4-30 A.M. corresponding with the 9th Loop Mail dashed into the Jamalpore station, shattered the buffers to pieces, and struck very violently against the station building, breaking it in several places. The driver says he lost all control over the engine, and thinking himself in danger, jumped out of it, but the fireman stood firm at his post. No loss of life occurred, but several passengers were slightly hurt. The driver has been suspended pending trial.

**CHANGES IN THE 2ND CIRCLE, P. W. D., BURMA.**—Mr. J. C. Wyatt, Executive Engineer, reported his return from the privilege leave granted him and assumed charge of the Thayetmyo Division on that date. Mr. W. R. Foy, Assistant Engineer, was relieved of officiating charge of the Thayetmyo Division and is retransferred to the Tharawaddy Division. Mr. W. R. Foy, Assistant Engineer, made over, and Mr. J. C. Wyatt, Executive Engineer, received, charge of the Thayetmyo Division. Mr. C. E. Housden, Executive Engineer, made over, and Mr. H. O. Walling, Assistant Engineer, on transfer from the 3rd Circle, received, charge of the Upper Chindwin District of the Chindwin Division.

**TRUTH STRANGER THAN FICTION.**—The following letter from the Assistant Manager of the East Indian Railway Collieries at Giridih, to the District Judge of Burdwan, speaks for itself:—"I am prepared to accept the appointment of Commissioner to enquire into the dispute between the parties, as the Agent, East Indian Railway, has accorded his permission to the arrangement. My fee will be Rs. 1,000 if the work does not take more than one week (6 days), and 10 Gold Mohurs for every day beyond that. Travelling and all Expenses out of pocket must also be defrayed. In case you nominate me, I shall be glad if you will note that my duties here will hardly allow of my taking up the work for about a fortnight."

**INDIAN JUTE.**—Bengal and Assam are, it is believed, the only two Provinces in India in which jute is cultivated as a fibre. The exports are chiefly to the United Kingdom and the United States, the share taken by each of these countries being 73 and 17 per cent, respectively, on the total exports. About a third of the imports into the United Kingdom, which is supplied almost exclusively by India, is re-exported to Continental Europe, which competes more largely every year with Dundee in jute manufactures. A large proportion of the supplies which India sends to the United States is, it is stated, comprised of jute-cuttings and rejections, which are turned to account by the inventive Americans for the purposes of paper-making.

**A SCANDAL.**—The District Board of Kurnool have taken nearly seven years to find that the District is too large

for one Engineer, and that two Supervisors under no professional control would be a better arrangement. This appears to us to be the most flagrant piece of jobbery ever attempted to be perpetrated under the system of Local Self-Government in Madras. We had occasion to refer to the treatment of the Kurnool District Engineer some time back, and we feel sure that the present attempt to get rid of him will elicit wide-spread sympathy. In the interests of the Profession we should point out to the lay-world that insecurity of position and doubtful prospects cannot be productive of the best results from those thus situated.

**BENGAL-NAGPUR RAILWAY AND THE BENGAL COAL PROPRIETORIES.**—The Agent of the B. N. Railway has now under consideration a series of coal sidings from the main Collieries Branch, in course of construction, to accommodate the outlying mines with a radial distance of from half to one mile from the last two miles terminating with Sanktoria. The conditions are very favorable, and should prove sufficiently inducive to coal interests desirous of sharing the advantages of cheap transport. The conditions are: 1st, land free for the location of the line; 2nd, 6 per cent., on the cost of the siding laid to the colliery; and 3rd, freight in addition, which is stated will be fixed at a rate to suit the coal proprietories, and be lower than that now paid by them to E. I. R.

**GANGA RAM'S POCKET-BOOK.**—The second edition of this well known "Pocket Book of Engineering," in Urdu, greatly revised and enlarged, by Rai Bahadur Ganga Ram, A.M.I.C.E., M.I.M.E., Executive Engineer, P. W. D., Punjab, is now ready and before us. It consists of two parts; the first giving useful Rules, Tables and Specifications, concluding with a Vocabulary of Engineering Words from English into Roman and Urdu, and *vice versa*; the second part giving 250 details of buildings and bridges drawn to scale. The whole is bound in the form of a little handbook, the Price of which is Rupees Two per Copy. It may be obtained from Messrs. Dwarka Nath & Co., Lahore. It is a very useful book of reference for Engineers and Subordinates.

**A SPECIAL ITEM FROM ASSAM.**—The Cherrapoonjee hill tramway, although completed long ago, is as far off as ever from being opened for traffic. It cannot be got to work, and the question now appears to be whether some more lakhs of rupees are to be spent in remodelling it, or the whole project to be abandoned. There does not appear to be traffic enough to make it pay, especially as potatoes—the chief item—are very uncertain. There is good coal to be found close to the top of the tramway, and it might be worth while for a company to obtain the concession to work the coal in connection with the tramway. The steamer companies, I. G. S. N. and Rivers Steam, are now working in opposition, which has much reduced the freights to and from Assam, greatly to the advantage of the planters.

**THE RAILWAY CONFERENCE.**—Regarding the work of the recent Railway Conference, a contemporary says that it is understood that the reports of the Sub-Committees submitting a set of new rules and regulations for working lines under construction and new standard dimensions were adopted with slight modifications: and the existing Indian Railway Conference regulations for through traffic were revised and corrected up to date by insertion of the new rules passed at the present Conference. These regulations cannot, of course, be brought into force until



they have received the approval of Government and the several Boards of Directors. The report on the result of the brake trials on the Sind-Pishin Railway, which will take place towards the end of this week, will, when received, render the work of the Conference complete.

**A HARD CASE.**—Another instance of the disposition of Government towards the C. E's. of the P. W. D. has accidentally come under our notice. An Executive Engineer is transferred from one administration to another without reference to his wishes, and ordered to serve beyond the frontier of India in contravention of his "Covenant." While *en route*, a mishap occurs—due to circumstance over which he has no control, or, as insurance companies would say, the "act of Providence"—under which he loses the whole of his personal effects by a ready and cheerful acquiescence with the orders of Government. But the *finale* is very different. An application for compensation was negatived on the score of establishing a bad precedent, and a memorial to the Secretary of State only elicited the stereotyped reply:—No ground for intervention!

**THE LATE MR. F. L. DIBBLEE.**—Another correspondent writes:—I have to record the death of Mr. F. L. Dibblee, M. Inst. C. E., Executive Engineer, P. W. D., at Calcutta, on the 28th September. The deceased was 51 years of age, and joined the P. W. D. in 1874 as Executive Engineer second grade, attaining the first grade in 1880, in which position he died. Considering that Mr. Dibblee had at one time—in 1867—officiated as Chief Engineer of the Great Southern India Railway, his non-advancement in the P. W. D. was not a little surprising. Mr. Dibblee was employed on the Toungoo-Mandalay Railway Extension in Burma whence ill-health necessitated a change to Hazaribagh, and he was just appointed to join Mr. Horace Bell on the survey of the proposed Delhi-Kotri Railway when he died.

**ACCOUNTS Branch, P. W. D.**—Major A. G. Begbie, R.E., Deputy Accountant-General and ex-officio Under-Secretary to the Government of India, Public Works Department, on return from furlough, is appointed to officiate as Accountant-General and Deputy Secretary to the Government of India, Public Works Department, during the absence of Colonel A. J. Filgate, R.E. Consequent on the above, Mr. R. G. Macdonald, officiating Accountant-General and Deputy Secretary to the Government of India, Public Works Department, reverts to his appointment of Deputy Accountant-General and officiating Under-Secretary to the Government of India, Public Works Department; and Mr. A. R. Becher, officiating Deputy Accountant-General and Under-Secretary to the Government of India, Public Works Department, reverts to his appointment of officiating Deputy Accountant-General.

**THE POETRY OF ENGINEERING.**—Sir F. Bramwell said, in concluding his inaugural address as President of the British Association at the annual meeting held at Bath this year:—Whether it be in the erection of the lighthouse on the lonely rock at sea; whether it be in the crossing of rivers or seas or arms of seas by bridges or tunnels; whether it be the cleansing of our towns from that which is foul; whether it be the supply of pure water to every dwelling or the distribution of light or of motive power; or whether it be in the production of the mighty ocean steamer; or in the spanning of valleys, the piercing of mountains, and affording a firm, secure road for the

express train; or whether it be the encircling of the world with telegraphs—the work of the Civil Engineer is not of the earth earthy, is not mechanical to the exclusion of science, is not unintellectual; but is of a most beneficent nature, is consistent with true poetical feeling and is worthy of the highest order of intellect.

**GOOD SERVICE PENSION.**—It is notified that on the recommendation of the Government of India, Her Majesty's Government has been pleased to confer good service pensions on Colonel Sir James Browne, K.C.S.I., C.B., Royal (late Bengal) Engineers, who held the following Appointments:—With Bengal Sappers and Miners, 1860. Assistant Engineer, Public Works Department, 1860-63. With Bengal Sappers and Miners, 1863. Assistant Engineer, Public Works Department, 1863-64. Assistant Principal, Civil Engineering College, Roorkee, 1864-65. Assistant Engineer, Public Works Department, 1865-66. Executive Engineer, Public Works Department, 1866-78. Engineer Staff, Quetta Field Force, 1878-79. Assistant Secretary, Public Works Department, 1882. Commanding Engineer, Indian Division, Egypt Expeditionary Force, 1882. Superintending Engineer, Military Works Department, 1882-83. Superintending Engineer, Harnai Road Command, 1884. Engineer-in-Chief, Sind-Pishin Railway, 1884. Superintending Engineer, Sibi-Quetta Railway, with the local rank of Brigadier-General, 1884-87.

**THE PIONEER—AGAIN!**—The *Indian Daily News* administers the following well-deserved snub to the "official broom":—"Why should it be supposed that a number of gentlemen, because they happen to be connected with Railway management in India, could not meet together to discuss questions connected with a desire to introduce greater uniformity of working on the different systems, without coming to fist-cuffs? And why should the fact that these gentlemen have actually met and discussed without fighting—at any rate, other than verbally—and have dined together amicably at the close of their deliberations, require to be chronicled as if something marvellous had happened? Perhaps the *Pioneer* will explain. When the Conference met, the Allahabad paper hinted, with most rare and delicate wit, that umbrellas and walking-sticks had to be rigorously excluded from the room. \* \* \* Though the Simla correspondents would have been delighted to vary their chronicles of small beer by a description of a shindy at the Conference, the proceedings passed without a hint of any hitch, much to the *Pioneer's* astonishment, and now the public are informed, as a most curious phenomenon, that 'the tone of the discussions was always, if earnest, moderate and conciliatory, everyone abating something of his particular aims and desires for the purpose of establishing a common understanding. The consequence is that much of the work that has been done is of an extremely practicable and serviceable character. Colonel Conway-Gordon's tact and temper as President is on all hands admitted to have greatly conduced to this desirable result'—which is as much as to admit that even Railway Managers, Locomotive Superintendents, and the like, may be gentlemen, and know how to conduct themselves towards each other with as much courtesy as even an assemblage of Civil Servants. Probably, most people outside of the *Pioneer* office knew it all before; but the Railway men may be pleased (will they?) to have a certificate of character from so eminent an authority on manners."



## Current News.

DR. BURGESS, the Director-General of the Archaeological Survey of India, has returned to India and resumed charge of his department at Simla.

THE proposal to convert the Tarkessur Railway Company, Limited, into an English concern with its head office in London has been revived.

THE Mysore Exhibition opens for judging on the 15th instant, and on the 16th for the public. It will continue for a week or longer, if desirable.

DR. KING, Director of the Geological Survey of India, and the original discoverer of the Singareni Coal Field, has visited Yellandalapadu and is quite satisfied with the surface and underground arrangements.

SECUNDERABAD was visited by a mild earthquake last week. The earthquake appears to have travelled along the railway line, while report has it that it was especially pronounced at Januma, Bowandgir and Warungal.

It is in contemplation to transfer one portion of the Dehra Mapping Office to Simla, to work in connection with the Intelligence Branch of the Quarter-Master General's Department, and another portion to Calcutta.

MR. HORACE BELL, who is about to undertake the Survey of the Rajputana "Desert" Line, arrived at Kurrachee on the 26th ultimo and passed through Lahore on his way to Delhi and Jodhpore, whence operations begin.

CONSEQUENT on the sudden appearance of cholera in Akola orders will be issued to the P. W. D. immediately to begin the "Water-works Scheme," which is in contemplation, and has been for a long time under consideration.

At the end of the month Sir Charles Elliot and Colonel Conway-Gordon will arrive in Lahore, en route for inspection of the frontier Railway. The tour will conclude at Kurrachee, whence Colonel Conway-Gordon will sail for Europe.

CREDIT is taken in the Bombay Municipal Report for last year for the estimated saving of 2,282,529 gallons per diem brought about by the exertions of the large staff employed for the detection of wastage by leakage of mains and service pipes.

MR. J. W. RUNDALL, Superintending Engineer, 6th Circle Madras Presidency, is about to take leave, and retire. He joined the P. W. Department in August 1855, his only senior now being Colonel Beatty, Superintending Engineer, 4th Circle.

MR. W. J. COLLINS is appointed to be Inspector and Secretary to the Commission constituted under the provisions of Act III. (B.C.) of 1879 for the periodical inspection of steam-boilers and prime-movers attached thereto in the town and suburbs of Calcutta and in Howrah.

Work on the fortified serai at Lundi Kotal is making steady progress, and by the end of this month all the outside walls will be finished. It is hoped that the water-supply scheme will be pushed forward, and also the opening out of the alternative route to the plateau through the Mullagori country.

At an extraordinary general meeting of the Municipal Commissioners of Howrah, last week, it was resolved that Government be asked for a loan of eight lakhs of rupees for the proposed water-works in Howrah. It is at present under contemplation to draw the water from the river Hooghly at Goosery, or further up, provided the cost will admit of it.

On the 186 miles of the Sirhind Canal no fewer than 1,484 tons of goods traffic and 1,149 passengers were carried during the month of August. But as the total receipts on account of tollage of boats did not exceed Rs. 517 and the cost of navigation including maintenance charges amounted to Rs. 1,674 there was a net loss during the month of Rs. 1,157.

MAJOR COAKER, R.E., who is to be a Deputy Manager on the N. W. R., is expected in Lahore on the 20th. Captain Pitt, R.E., will probably be the other Deputy Manager, on the new system. Mr. J. M. Rutherford, who has been acting as Manager of the Punjab Section, will become Traffic Superintendent of the whole line. Mr. Mathew, who is now acting as Traffic Superintendent of the Punjab Section, goes to Simla to take the place of Mr. Jacob, going on furlough.

## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*

### CHANGE OF MINE MANAGERS.

SIR.—With reference to the para in "Notes and Comments" of your issue of 29th ultimo in regard to the change of Mine Managers, it might be interesting to the shareholders and friends of Mr. I. J. Whitty to know that during the time he has been in charge of the B. C. Co., Ltd., the profits have been exceptionally high, and that the profit for the last six months, viz., Rs. 2,68,988, has only been exceeded once within the last twenty years, viz., half-year ending 30th April 1880 when the amount was Rs. 3,08,839; but the prices that year were 20 per cent., better than they are now.

It is to be regretted in the interests of the shareholders and the company, in general, that a man of his experience and capabilities should be disengaged from the concern.

ENTERPRISE.

CALCUTTA; September 30.

### WELL VERSUS CANAL WATER FOR IRRIGATION.

SIR.—In the "Literary Notices," in your issue of the 22nd instant, the last paragraph is as follows:—"In the matter of irrigation, well water has once more proved itself superior to canal water, although the cost of the former is double that of the latter."

I do not understand how any canal water can be inferior to well water, nor how well water can be so cheaply raised as to only cost double.

In my experience, the best of well waters contains salts injurious to cultivation, and manuring is a necessity with well irrigation. I presume the canal water referred to is the tail water of the Ganges Canal, and this, though it may have been deprived of all fertilizing matter on its long course, should be practically as free from salts as rain water.

Taking the price of canal water at Rs. 2 per acre, I should like to know by what contrivance water can be raised, say 20 feet, for Rs. 4 per acre.

There are evils in canal irrigation, but they do not arise from the quality of canal water or from its cost.

E. A. S.

KOREISHI; September 20, 1888.

### REFINED CRUELTY.

SIR.—Verily sir we live in strange times. The blessed Department of Public Works seems to be a scene where the gods of the Secretariat love to display with theatrical effect their most amusing vagaries for the delectation of folks of the lower order. You are aware of the grievances of the Calcutta College men of the pre-guarantee years who, rightly or wrongly, believe that they have not received at the hands of Government the measure of consideration and justice which they think they fairly deserve in their struggle for the public service. God forgive them for their discontent and apparent ingratitude.

The powers that be being notoriously deaf to all rhyme and reason, it took the earlier graduates of the Calcutta College ten long years to excite anything like a pang of pity for the poor fellows that passed the Engineer's test year after year, only to be herded with Overseers of sorts in the P. W. D., with this distinguishing privilege that in their case the Government reserved the right of sacking them with or without a month's notice! The state of things was indeed as bad as it could well be, but the poor aspirants to name and fame, however, nothing daunted, made the best of a bad job and found balm in their worst moods in the hope that the state of things was much too bad to last long. It was chiefly through their quiet and temperate representations that even the callous hearts of the P. W. D., gods after ten years of supreme indifference awoke in 1884 with sudden qualms of conscience, and proclaimed a guarantee of "one-and-a-half" appointments for the benefit of the then present and future generations. It is well the gods did so in time, or the folks of lower order would never have suspected that the gods were capable of such a feat of disinterested generosity. Well having premised these facts, permit me to state that it is not quite three years and three months since, say for instance, Rai Annada Prosad Sircar, Sahib, got one of the guaranteed Assistant Engineerships among his fellow-passed men of better mark and merit, and the last Calcutta Gazette announces his promotion from 2nd to 1st grade of Assistant Engineers.

Whereas, those of the earlier graduates,—including a prizeman and distinguished students among the number—who had passed



out before the Rai Sahib had received his first lessons on bricks and tiles and who sacrificing their pride at the altar of their need accepted the inevitable 1st grade Overseership, are unto this date 1st grade Overseers. Be it said to the credit of those concerned that the lucky "Engineer" gets his promotions by leaps and bounds two promotions in three years—whereas the unlucky subs, albeit his seniors in age, experience and merit, do not get one promotion in three years in their much humbler sphere!

One needs to have more than flesh and blood to pluck up heart to bear such misfortune with equanimity. But, no, that is not all, who knows that some of these unlucky subs might not some day stumble on the path of the Rai Sahib, and be placed under his orders. Only the Secretaries in the Writers Buildings know what worse humiliation there may be in store for them. If they were guilty of high crimes and misdemeanors they could not have been worse off than they are now. This is too much of a distinction without two straws of a difference, and it is earnestly to be hoped that the present popular Secretary will give this matter a moment's thought, and try to make the bitter lot of the unlucky subs a little more palatable, if possible, by judicious recognition of merit and by promotion.

## DYNAMITE.

## MOORE'S IMPROVED CAST-IRON SLEEPER.

SIR,—A few days ago, a friend wrote to me concerning some letters signed "Railroader," which appeared in your journal during June and July last. I have used this *nom de plume* for some years, when writing to Railway journals in England and America, and also for the Indian Press; and my friend supposed, "as did many others," that the letters referred to emanated from me. I mention this to avoid any further misapprehension, and hope that the gentleman who has ("unwittingly I am sure") adopted my cognomen will kindly select some other, as it would be inconvenient for me to do so after using it so long.

I hope to see more of his criticisms on permanent way matters before long, although I cannot agree with all he says: For instance; in his letter of the 14th July, he states that keymen are employed to prevent the spikes from being drawn out of pine sleepers by the movement of the train. This is not correct: the keymen's chief duty is to keep the wooden keys tight in the chairs, and I never allow them to touch a spike except when renewing a broken chair, as more harm than good is done by hammering down spikes that are at all loose. The only effectual remedy is to move the sleeper transversely, and get a fresh grip for the spike. Keymen are employed on roads where there are *no spikes to work loose*; and where no pine sleepers are used.

2nd. The vertical web above the cotter slits of the D. and O. sleeper never breaks when the holes in plate and tie bar are true, and the fittings properly applied.

I, however, quite agree with him that Mr. Moore's sleeper has weak points; I feel sure that it will break under the rail, and if, as I understand, the rail is only kept against the outer jaw by the tie bar being cotted up against it, I consider this another weak point. One of the advantages of the D. and O. sleeper is that it is so tied together by the wrought iron tie bar and keys, that it is not only *much* stronger than any other form of cast iron sleeper, but widening of the gauge is *impossible* even after the plate is broken. I have seen these sleepers run over by twenty trains a day for more than a month after they were broken, without the line shewing any perceptible defect. With Mr. Moore's patent, were two consecutive sleepers to break in a curve, the result would probably be a derailment. Mr. Moore appears to be of opinion that the D. and O. sleeper breaks across the centre in consequence of the leverage due to the rail being at so great a distance from the bottom of the sleeper, and, "Railroaders," theory is that it is want of strength. I think *both* are wrong; breakages of this class, although not frequent, are due to the plates not being properly packed. Every one who has had experience with native platelayers is aware how very difficult it is to make them pack that portion of the sleeper immediately under the rail, and it is the ends being packed hard, and the centre left loose that causes the D. and O. sleeper to break; where they are carefully packed with small ballast the breakages are less than  $\frac{1}{2}$  per cent.

## RAILROADER.

October, 2, 1888.

We have a lurking suspicion that this request has been suggested by the appearance of a letter that has lately been published in these columns relative to the identification of an original and recognised *nom de plume*. But unlike the latter it is pretensions and ridiculous in its contentions. We have seen certain communications of late somewhere bearing the same cognomen as that used by the writer in our columns to which reference is made: but, we would assure our correspondent that no one who regularly reads American and English Engineering papers will for a moment mix up a bundle of extracts and quotations obtained second-hand with the original, sound and sensible observations of the professional gentleman who favored us with his communications.—Ed., I. E.]

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## General Articles.

### THE SIMLA TOWN HALL.

WHEN active measures were taken towards erecting a Town Hall in Simla, the Municipality applied to Mr. W. Irwin, Superintending Engineer of the Simla Imperial Circle, for designs, with which he supplied them gratis towards the end of 1884.

The calculated cost of the whole structure, according to this first set of drawings supplied, was not to exceed Rs. 1,65,466, and even here a saving was expected. This estimate was accepted by the Municipality without a question of its accuracy, though it had been submitted to no scrutiny from either Engineers or experts. The Punjab Government sanctioned this estimate, but at the same time informed the Municipality a sum of Rs. 2,20,000 would be the more probable outlay. It did not even then occur to the Municipality to take the precaution of having the estimate scrutinized. Hence it may be that the Kursaal so-called has exceeded its first, second and third estimates.

The supervision of the work was undertaken at the request of the Municipal Building Sub-Committee, by Mr. F. B. Hebbert, Executive Engineer (Imperial Circle), as a Municipal Commissioner, "and in no sense as Engineering adviser to the Committee."\*

But the fact that the cost of the building has exceeded its first, second and third estimates, does not tend to prove that it has been in itself an expensive one. On the contrary, all acquainted with such work are agreed that it is a remarkably cheap erection. As a demonstration of this assertion, take another recent structure of the same character here, and compare costs. The new Kutcherri, which, like the Town Hall, is built throughout of local stone, and cutstone from Kalka or thereabouts, was completed for about Rs. 2,00,000; and a further outlay of Rs. 11,000 was subsequently found necessary to render it watertight. Now the Town Hall is about four times the size of the Kutcherri, containing as it does 234,000 cubic feet of solid masonry exclusive of about 28,000 cubic feet of cutstone. The cost of completing this entire quantity, including timberwork, roofing, and iron—with all minor items—such as roadways, railings, &c., has been covered by a total of something over Rs. 3,50,000. At present the finishing of the great tower, which is architecturally much required to give a completeness to the building, is not contemplated; but the parapet walls, the skew-tabling, the pediments of buttresses, and the pointing are being somewhat leisurely proceeded with. A total expenditure of Rs. 4,00,000 ought to complete the Town Hall in every detail, and large as the amount may seem, the Kursaal will even then be comparatively the cheapest public building in Simla. This has been already recognized by the Punjab Government, which assured the Secretary of State for India, as the result of the strict enquiry of 1887 into the cause of the excesses, that the rates for both material and labor were reasonable and even low.

The style of Gothic employed has been much criticised, some maintaining it is a mixture of different foreign Gothic styles, and therefore in bad taste; while the majority are of opinion that it is the most picturesque building in the capital. It would be most undisputable were its great tower—"the one thing wanting"—completed. It is built in beauche masonry, a style introduced into Simla by Mr. F. B. Hebbert. The local quarries supplied the stone (grey limestone) for the rubble masonry; but the fine cut stone used in tracery and mullions of windows in pillaret, doors, tablets, gargoyles and such like was quarried at Kalka. The highest or south elevation is towards the Mall, from where entrance is gained to the Police Station, the Municipal Offices, the Masonic Hall and Supper-room, and the Theatre. This last deserves special notice, being the greatest success of the

block. Its area is 60 feet x 50 feet and it is lofty in proportion, occupying two storeys of the building, the height from the floor being 27 feet. The stage is a remarkably fine one, its area, 50 feet x 30 feet, affording ample room for dramatic purposes. As regards acoustics, the Theatre is pre-eminently successful, few home theatres excelling, or even equalling it in this respect. There are sittings in the stalls for over 100; in the boxes, of which there are two tiers, for 112, and in the gallery which, though about the best part of the Theatre for seeing and hearing, has been reserved for the second-class seats, there is accommodation for about 50. With regard to decorations, it is perhaps rather destitute of ornament. The iron pillars which support its roof, also of iron, are painted white; the roof itself is also white, and is divided into panels, a few of which are filled with handsome fretwork ventilators. The boxes are tastefully draped and painted, so that the little decoration there is, is in perfect good taste.

The first floor, besides the upper portion of the Theatre, contains the Station Library and two fine large reading rooms, these three last being separated from the upper half of the Theatre by a wide corridor, which is used as a promenade, and at the north end of which is the Volunteer's armoury and Adjutant's office. Above the Theatre is the ball-room extending the height of the roof—60 feet.

It is a fine hall, but there is much to be desired in the way of symmetry. A celebrated architect at home informed us the right proportions for a room are two cubes. The ball-room wants length. Two galleries were run along the sides to take off the breadth, but they unfortunately do not produce the desired effect. Two rows of Gothic windows on each side give ample light, while the rose windows in the gables throw bright streams along the lofty arched ceiling. The band gallery at the east end is seldom used; and the room is the despair of musicians—vocal and orchestral. A peculiar vibration here defeats all efforts to be heard distinctly. A corridor, the counterpart of that below, runs between the ball and drawing rooms. This last is at present utilized as a reading and lecture-room by the United Service Institute. Above it, and separated from the upper portion of the ball-room by a third corridor, is the supper room.

These wide lofty corridors are the admiration of every one. Their groined roofs, and subdued light, give them some resemblance to cloisters of olden times. The north and south main staircases also wind upwards under groined roofs, the same style of ceiling being carried on in various entrance halls and vestibules throughout the building. It is a matter to be deeply regretted that where one looks up to admire, the eye is met by hideous slimy patches of damp which disfigure portions throughout the entire building. The concrete used so largely in roofing, pillars, and stair railings is cracked in many places from the effects of the present leakage, and it is doubtful how great a sum will eventually be necessary to thoroughly repair the damage the building has sustained since last season.

As yet the place is far from finished. Painting, of doors and windows, distempering of walls, repairing, lighting and furnishing all yet remain to be done.

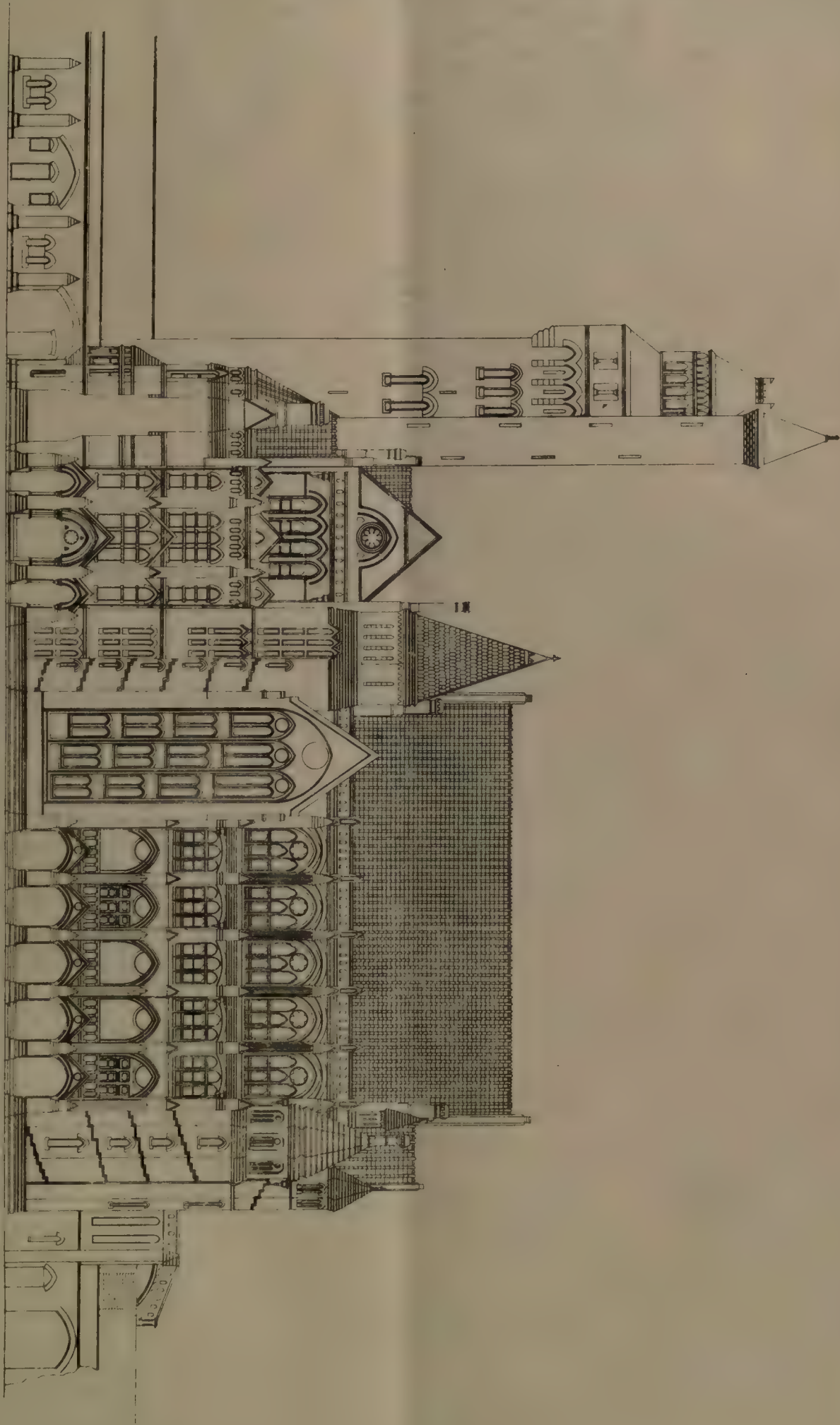
The Kursaal is a favorite place of resort throughout the year, and whatever may be the decisions as to its architectural beauty, there can be but one as to its utility. It is a want supplied, and we wonder how we managed without it so long.

The preliminary surveys for the construction of the Siberian Railway have now been completed as far as Irkutsk, and it is expected that half the line will be marked out before the winter sets in. It is proposed to construct a branch line to the Trans-Baikal Province, between Lake Baikal and the Chinese frontier. The part of the line from Samara to Ufa, 485 kilometres in length, is already opened. The continuation from Ufa to Stauisk is now being constructed. The line is to extend in time also to Omsk, Tomsk, and Irkutsk.

\* Mr. Hebbert's pamphlet explaining his position with regard to the Town Hall.



TOWN HALL, SIMLA.









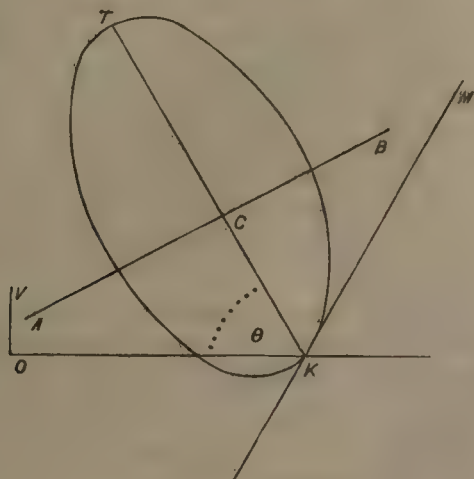
## BICYCLE RUNNING.

BY A. EWBANK.

## III.

WE now pass on to another peculiarity of a rolling wheel.

Fig. 2.



In *fig. 2* let  $OK$  be a level line due east. Let  $KM$  be a level line due north. Let a wheel be placed along the line  $KM$  and with its plane vertical. Let the wheel then be made to rotate about the line  $KM$  through an angle  $90^\circ - \theta$ . The wheel then has an inclination  $\theta$  to the horizon.  $TK$  is a diameter of the wheel and  $TKO = \theta$ .

The wheel if placed at rest in such a position will fall and lay its centre on the line  $KO$ .  $ACB$  is a line normal to the wheel plane, and  $C$  is the wheel's centre. Suppose that at the moment indicated in the figure, the wheel has a rotation in its own plane of the direction shewn by the arrow  $L$ .

Then at that moment the wheel is rolling along the line  $KM$ . We shall call this line or direction the momentary track. The wheel has a certain mass and a certain distribution of this mass. One wheel might have most of its mass near the centre, while another of the same diameter, and the same total weight, has most of its mass near the tire. The wheel has a certain diameter. Also the  $L$  rotation is of some given amount.

Out of all these elements it results that the wheel will not fall down near the place where it is at present, but will roll on a track which bears to the west.

This track is a curved line. If the  $L$  velocity is not lessened, the curve is a circle whose centre is some point  $O$  due west of  $K$ .

The radius  $OK$  of this circle depends on the elements before mentioned. So also does the linear velocity with which the wheel runs over its circular track. So also does the angular velocity with which the wheel describes this track as seen by an observer at  $O$ . The linear velocity is expressed in so many feet per second. The angular velocity is expressed by stating the number of seconds required for the wheel to complete one revolution.

The point for us to notice is that, there is no connection whatever between a rolling wheel taking a slope  $\theta$  for its plane, and the wheel falling to the ground. The slope has no tendency to produce a fall. Its tendency is solely to make the body take a curvilinear track. If the wheel can keep its  $L$  rotatory velocity unchanged the angle  $O$  will also be unchanged in amount. But the wheel plane will change in direction.

Imagine the wheel in *fig. 2* to be connected to the point  $O$  by two stiff rods  $OK$  and  $OT$ . Through  $O$  draw a vertical line  $OV$  and make the body  $OKT$  revolve with uniform angular velocity about the axis  $OV$ . Then the successive positions of the wheel plane will be identical with what we will call the dynamical positions. By making the body  $OKT$  revolve about  $OV$ , we keep on the ground one and the same point of the wheel.

But the wheel as a plane, and not as a series of small particles of wood or metal, is the same in the two cases.

While the wheel is travelling with uniform movements along its circular path, let a small blow  $R$  be given normally to it. The wheel will shew the effect in a change of inclination. But instead of falling, it will recover itself and will pass on executing a series of wobblings; during which its track will no longer be the circular path. The new track, however, will not diverge widely from the original path, and if no further disturbance is offered to the wheel it will travel round  $O$  in a curve, which, approximately, we may still describe as a circle.

When a man first tries to ride a bicycle and the bicycle slopes over to one side, the rider thinks he is going to fall. This is a delusion under the then conditions, but the rider by changing the conditions proceeds to transfer the delusion into a verity. For he stops the rotation of the wheels by putting a drag on the treadles. Then each wheel does fall and the rider feels convinced that his forecast was correct. If the rider had had the sense or the hardihood to ignore the apparent danger of falling, and to work the treadles with unchanged rapidity, he would be unable to fall and he would simply move round in a curve.

So far is the experienced bicyclist from dreading a slope that he is continually, that is frequently, creating a slope of set purpose and as a feature of proper driving.

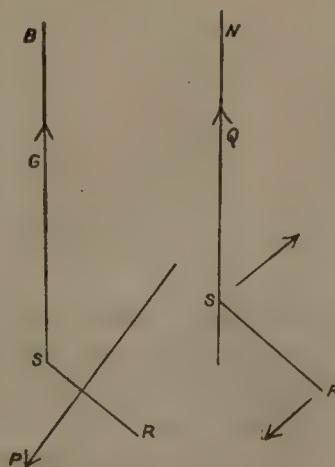
In some previous papers on the "Properties of Fluids" we noticed the popular idea that the rudder of a ship is solely used to change her course, and at other times lies idle. We shewed that the rudder is continually used to prevent the ship from changing her course and only occasionally used to produce a change.

Similarly, there is with some people an idea that a bicycle is meant to run upright, and that to change the course we should begin by turning the driving handle. The fact is that a bicycle is practically never upright, and that to change her course a turn of the handle is not the proper preliminary. The real function of the driving handle will be developed in later papers.

A man who believes that the function of the handle is to steer, will call the driving wheel a steering wheel and the handle he may then call the rudder or helm.

The mere fact that the handle is in front of the machine, does not disqualify it for acting as a helm: but it does involve a certain disadvantage, which we proceed to consider.

Fig. 3.



In *fig. 3* let  $S$  be the stern and  $B$  the bow of a ship which has been sailing or steaming due north with the rudder  $SR$  inactive, or lying along  $BS$  produced. Let  $SR$  be now moved into an eastward or starboard position as shewn in the figure. Then we know that the head of the ship will deflect eastwards.

This action of the rudder may be explained in two ways, and one of these will suit us better than the other for an illustration of bicycle or tricycle steering. Thus we may say that water is piled up in the angle  $BSR$ ,



and that there results a water pressure  $P$ , under the action of which the ship rotates clockwise about her centre of gravity  $G$ . This explanation is sound, and it is the one we should naturally choose in discussing ship motions.

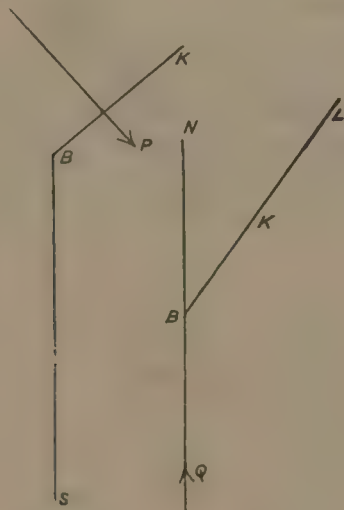
But we may look at matters from another point of view. A ship is a heavy mass, and at the time  $S R$  was forcibly moved into the position of the figure, the ship had a considerable momentum in a due north direction. In consequence, the rudder  $R S$ , considered as a body distinct from the ship, is called upon to travel in a semi-crab or semi-sideways fashion, as is indicated by the figure.

Let the velocity northwards be  $V$ . Then this is equivalent to two velocities. One of them is  $V \cos (180^\circ - B S R)$  in the direction  $R S$  produced. The other is  $V \sin B S R$  in the direction of  $P$  reversed. If the rudder could separate its movement from that of the ship it would tend to move nearly in the direction  $R S$  produced; in which direction it encounters less resistance from the water. The velocity in the direction  $P$  reversed encounters relatively more resistance from the water. Thus on the whole the tendency of the rudder is to north-westwards from the old course due north. This westward working of the point  $S$  does—as long as the rudder is rigidly connected with the ship—owing to the helmsman keeping the angle  $B S R$  unaltered—cause the bow  $B$  to deflect Eastwards.

The effort of the rudder is always to improve its own position only, and if the helmsman ceases to interfere with and control it, it will take the position which puts it in line with the keel of the vessel, that is, in line with the velocity forced upon it.

While yet the helmsman keeps the angle  $B S R$  unchanged, we see that the body  $R S$  is *pulled* through the water by a force  $Q$  which acts obliquely to the line of the rudder.

Fig. 4.



Now let us pass on to *fig. 4*, wherein we shew a vessel whose bow is  $B$  and which has her rudder fixed at the bow. Let the ship have been sailing due north with the rudder in the neutral position. Let the rudder be moved eastwards into the position  $B K$ .

We may, as before, say that a water pressure  $P$  causes the ship to revolve clockwise about a vertical axis through  $G$ . Thus the effect on the ship is the same as before.

Let us now consider the rudder as a separate body. The momentum of the heavy ship is causing the rudder to move through the water obliquely to its line of figure. Let the velocity northwards be  $V$ . Then this is equivalent to two velocities: one of these is  $V \cos N B K$  in the direction  $B K$ . The other is  $V \sin N B K$  in a direction normal to  $B K$ . The former direction is that of least resistance from the water. Accordingly, the rudder endeavours to take this direction. In taking this new direction or in diverging into some line between

$B N$  and  $B K$ , the rudder drags the ship round because the helmsman preserves the angle  $S B K$  unchanged. The rudder, therefore, now aims at a new direction eastward of the line  $B L$  and so on.

And we notice that here the rudder  $B K$  is *pushed* forwards by the action  $Q$  of the mass of the ship.

In *fig. 3* the rudder  $S R$  may be said to be arranged for stable equilibrium. It always, if disturbed and then left free, returns into a line with the keel. In *fig. 4* the rudder  $B K$ , instead of endeavouring to return into the line with the keel, has a tendency to double back—making the angle  $S B K$  become nearly zero.

This peculiarity of the rudder, when placed at the stem or bow, is sufficient to account for the fact that the ship-builder prefers to place the rudder behind the ship. There are other reasons for choosing the stern location, but we in our bicycle or tricycle reflections are not concerned to discuss them.

In a tricycle *fig. 3* may illustrate the plan of having a steering wheel in the rear. In *fig. 4* we may imagine we see a tricycle with the steering wheel in front. We may also imagine that *fig. 4* shews us a bicycle with the turnable wheel in the usual position. Then *fig. 3* would denote a bicycle in which the driving wheel is not the front wheel. The ordinary bicycle is not arranged to go backwards, i.e., with the little wheel running in front. But there is no difficulty in making such a bicycle, though we are not here asserting or implying that such a change would be an improvement.

We desire, however, to call attention to the point that if in a ship a tricycle or a bicycle our slewable or turnable portion is *behind*, this portion has a tendency to return to the neutral or inactive state whenever the helmsman or driver releases it from constraint. On the contrary if the turnable portion is in front, as it is with some tricycles, and with all bicycles, the tendency of this portion is not to return to a line with the rest of the machine, but to get into a worse state of disorganisation if it is left to its own devices.

We conclude, therefore, and we recommend the conclusion to builders and riders of tricycles—that if a machine has two large equal wheels side by side and a smaller central wheel for steering purposes, then this small steering wheel should have its place behind.

## ARCHED HOLLOW ROOFS.

FOR several years past brick arches resting on the lower flanges of rolled joists have been adopted as a common form of construction to support roofs and floors, especially in important Government and Railway buildings. The drawbacks which this form is considered to possess are as regards heat and resonance.

To obviate this a hollow and flat-arched form—*vide* annexed illustration—is about to be tried: it is to be made of Raneegunge terra cotta in voussoirs about  $9'' \times 7''$  of standard spans of  $4'$ . The top may be finished off as may be found necessary.

In order to roof over a room of certain size it will have to be subdivided by means of large joists or girders so as to take joists of the standard size. This will if anything like to an improved and better form of internal construction by the introduction of cross girders and pilasters carrying them.

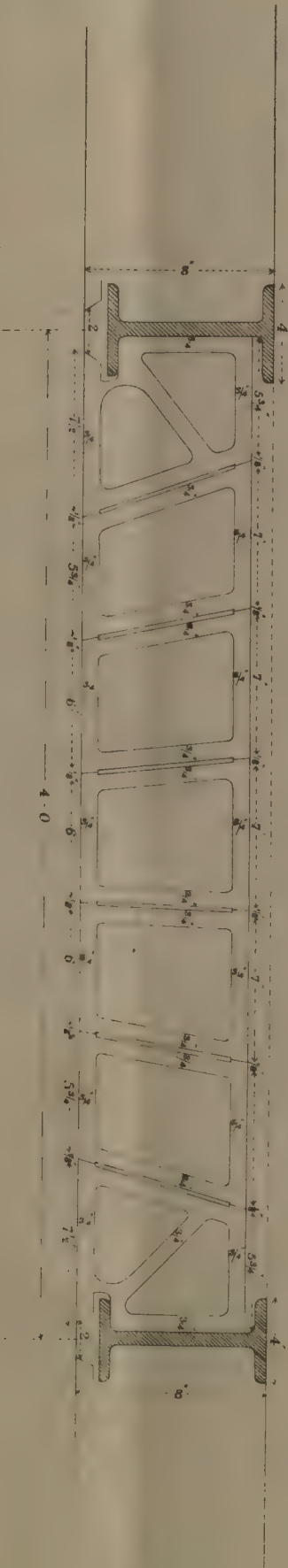
The flat ceiling will be much less resonant, especially when broken up into compartments by the girders and will lend itself more readily to decorative work—in contrast to the everlasting beams and burgahs.

The air space enclosed in the hollow voussoirs will naturally act as a non-conductor of heat.

Some practical experiments will we learn be made with this improved form, which we might mention is due to Colonel Neill, the Superintendent of Works in Calcutta and we hope to be able to communicate some useful information on the subject to our readers.



DETAIL OF HOLLOW ROOF.  
FLAT ARCHING OF TERRA COTTA VOUSSOIRS.









## NOTES FROM HOME.

*(From our own Correspondent.)*

THE British Association has held its meeting this year at Bath, and considerable interest was evinced at one of the earlier gatherings last week in the Mechanical Section, when Colonel Gouraud practically explained the Phonograph, which he did in detail. He shewed an improved instrument, having the wax cylinder previously exhibited by the President. "The last Rose of Summer" was given off and distinctly heard by the audience. The original air was played in New York a long time ago and has been reproduced some thousands of times. The Colonel stated that no less than five improved machines were on their way from America. Great interest was also manifested in the address delivered by Mr. Preece describing the rival systems of the phonograph and the graphophone. Mr. Edmund, followed with a description of the Tainter graphophone machine. This machine it was stated was used in Congress for work in connection with reporting proceedings and by members for the dictation of their correspondence.

A highly interesting and technical discussion took place on the question of lightning conductors. Mr. Preece, of the Government Department, attacked certain conclusions arrived at by Professor Lodge in his Mann lectures before the Society of Arts on this subject. In 1881 the Conference on lightning conductors issued a report approving copper wire, and in his lectures Professor Lodge dissented from some of the conclusions arrived at by the Conference, and insisted that copper wire was not better than iron, and that round rods were not better than flat. Mr. Preece said that, as a practical man having 500,000 lightning conductors under his charge, he supported the conclusions in favor of copper wire, as arrived at by the Conference of 1881. Some of the highest authorities took part in the discussion, in the course of which opposite views were enunciated on nearly all the points raised.

Colonel Hazard described a system of underground Railway communication in great cities. He considered there should be slow trains of great capacity with frequent stations, and there should be fast trains with few stations, so that considerable distances could be traversed within the city at a speed approximating the trunk lines. There should be galleries at the sides of the lines and between the Railway and the houses for the housing, inspection, replacement and repair of all pipes and wires, of sewers, water, steam, pneumatic, electric and other requirements or conveniences which are necessarily generated or produced at some central point and can be distributed or served only through the public domain over head or under foot. The plan of construction was very elaborately shewn by models, and the author stated that he considered the adoption of the system for the streets of every great city would effect an economic revolution.

At the recent Conference of Sanitary Inspectors at Brighton, about 130 members of the Association from all parts of the Kingdom attended. The President, Mr. Edwin Chadwick, C.B., was unable to be present, and his address, which was a full protest against all the evil influences which stood in the way of the full development of sanitary science, was read by Dr. Richardson. It was mentioned that the veteran sanitarian had reached the age of 89.

It is notified that the amalgamation between the Parkes Museum and the Sanitary Institute of Great Britain has taken place under the title of "The Sanitary Institute" (Incorporated August 1888). The memorandum of association of the newly constituted body has been signed by Mr. Edwin Chadwick C.B., Sir Douglas Galton and other well-known sanitarians.

Several reports having appeared giving descriptions of the opening of the connecting links completing the Railway communication between Calais and Constantinople, a correspondent of a London paper gives an interesting account of his journey over the ground, and concludes by saying that by the 1st of October he has no doubt that the through arrangements will be in perfect working order—that the ordinary carriages of the various sections of the system are much more comfortable for the journey they have to perform than the carriages of many of our English lines. The whole journey from London to Constantinople via Calais, Bale, Zurich, the Aarberg Tunnel, Musbruck and Vienna is accomplished in 94 hours of actual travelling.

On the 1st of next month the London, Chatham and Dover Railway will open their Greenwich Extension line, which has

been in course of construction during the last two years. Hitherto the Company have had no direct communication with Greenwich, their nearest station being at Blackheath Hill, which is upwards of a mile from Greenwich. The new Rail way is a continuation of the Company's Extension from Nunhead to Blackheath Hill, which was opened some five years ago. The opening of the line will give the Company and the town of Greenwich many advantages.

The Committee appointed at a recent meeting in Birmingham, to consider a proposal for the construction of a canal between Birmingham and the Weaver Navigation in Cheshire, has reported favorably as to its practicability and the prospect of its construction at a reasonable cost. Guarantee fund to defray the expenses of a detailed survey, and the preliminary steps for an application to Parliament is to be opened. The project is regarded in the black country with considerable favor.

In connection with the services of very fast express trains to Edinburgh next season, amongst many suggestions discussed in Railway circles for removing the obstacles which stand in the way of long continuous runs, and rendering them safer, is the employment of a third man on the engine in the capacity of a sub-fireman. The labor and anxiety attendant upon the firing of a powerful engine running at 60 or 65 miles an hour for four hours continuously is found to be far too much for one man. In that space of time the fireman has to manipulate over two tons of coal, breaking a large quantity of it and transferring it from the tender to the furnace. The third man could also assist in the efficient lubrication of the connecting rods and other parts of the locomotive.

## Official Papers.

## PUBLIC SERVICE COMMISSION.

FROM G. H. D. Walker, Esq., Under-Secretary to the Government of India, Public Works Department, to the Secretary to the Government of Madras, Public Works Department, dated Simla, 15th June 1888, No. 1432 G :—

In the report issued by the Public Service Commission, copy of which has already been forwarded to you by the Home Department, the following recommendations are made regarding the Engineer Establishment of the Public Works Department in Chapter X., paras. 91—98, of the report :—

1. That the Engineer Establishment of the Public Works Department should consist of an Imperial Branch and of Provincial Branches.
2. That the Imperial Branch should consist of such a number of Royal Engineers as may be required as a reserve for military purposes over and above the officers employed in the Military Works Branch and of Civil Engineers recruited in England.
3. That the strength of the Imperial Branch should not be greater than is necessary for purposes of control and direction, and for the execution and repair of works calling for high Engineering skill, and that the recruitment from Cooper's Hill Royal Engineering College, which appears at present excessive, should be regulated accordingly.
4. That the conditions of service in the Imperial Branch should be fixed with a view to secure the necessary qualifications in England, and should, as far as possible, be uniform for all officers employed in it.
5. That the Provincial Branches should be of a strength adequate for the construction and maintenance in the several provinces of works not ordinarily calling for high Engineering skill.
6. That the recruitment for the Provincial Branches should be made by the direct appointment to the lowest grades of qualified Engineers from the Indian Engineering Colleges, and in exceptional cases by promotion from the Upper Subordinate grades.
7. That there should be at least one College in India thoroughly well equipped for providing a high education for Engineers for the Provincial Branches, and that such College should be open to all classes of Her Majesty's subjects.
8. That the conditions of service as to pay, furlough and pension should be fixed for the Provincial Branches without reference to those of the Imperial Branch.
9. I am directed to request that these recommendations may be considered by the Government of Madras in the light of the suggestions put forward in the accompanying memorandum, which has been prepared in this office as a basis for carrying out in their practical application the recommendations of the Commission.
10. The chief points on which definite proposals are required are enumerated in the first paragraph of the memorandum, and are fully discussed and proposals suggested in the succeeding paragraphs.
11. In regard to the first point, the recommendations of the Government of Madras are particularly requested as to the number of charges, if any, that must be held by men of the Imperial Establishment in Madras; in other words, what figures are recommended for the Establishment of Madras to be placed in column D of table A in substitution of those tentatively inserted by this office.
- I am also to inquire whether, in your opinion, the Engineers of the Railway Branch should be wholly Imperial, or whether there should be a mixture of Provincial men, (To Madras, Bombay, Bengal, North-Western Provinces, Punjab and Burmah only).
12. An equally important question is whether, in the opinion of His Excellency the Governor in Council, a Provincial Service should be created between the proposed Imperial Service and the existing



Subordinate Service, or whether the present Upper Subordinate Staff, if increased in numbers, and perhaps improved in training, would suffice to perform the duties of the Provincial Service.

13. I am further to inquire whether, with reference to the 7th recommendation quoted above, the Government of Madras is satisfied with the training of the Indian College, Madras, from which it now receives such of its recruits as are educated in this country, or would desire any other mode of recruitment for the Provincial Service, or any alteration in the system of education pursued in the College with which the province is connected.

14. On these as well as on the other subjects, mentioned in the memorandum, and also on any other points touched upon by the Public Service Commission, the views and recommendations of His Excellency the Governor in Council are solicited by the Government of India, and I am to request that a reply to this inquiry may be furnished at the earliest possible date, and that, if possible, its return to this office may not be delayed beyond the 15th July.

#### ENCLOSURE.

*Scheme for separate Imperial and Provincial Establishment, Public Works Department, prepared with reference to proposals by the Public Service Commission.*

Assuming that separate Imperial and Provincial establishments are to be organized, as recommended by the Public Service Commission, the points which have to be authoritatively settled are the following:—

1st.—What, looking into the far future, is to be the respective strength of each establishment? Does table A (see paragraph 2) give a fair description for the two services, and is the future Railway Branch to be wholly Imperial? On this decision depends the rate of recruitment to be now ordered in substitution for the present rate.

2nd.—What are the rates of pay and promotion for the Provincial Establishment to be?

3rd.—Are the superior appointments to be made on one scale of pay, and open by selection to Imperial and Provincial men alike?

4th.—In distributing the present establishment between Imperial and Provincial, at what grade are we to draw the line of separation in regard to men who are classed as "Indian Engineers," and how far are we to give better prospects as regards pay to the men now in Government employ who may be placed in the Provincial Establishment than to men in future entering the establishment?

5th.—Looking to the smallness of the numbers in each service (as in statement A) in even the largest provinces, and still more in the smallest, is it possible to work them as separate and independent services, or should they be placed as regards promotion on a general list for all India, though without liability to transfer from one province to another except in the cases of Local Administrations? These points are discussed with tentative suggestions in detail below.

#### Sub-head 1.—Strength of each establishment.

2. In order to illustrate what may be taken as a possible distribution of the present (revised) charges and posts of the several provincial lists of the Public Works Department between an Imperial and Provincial Establishment, a table marked A has been prepared.

3. Columns B and C shew the revised strength as far as it has been settled, and the number of executive charges on these lists, which include all but the Railway and Military Works Department lists.

4. The important columns upon which the rest are based are columns D and E. These distribute the executive charges between Imperial and Provincial Engineers. The distribution must be more or less arbitrary. In provinces where, as in Bombay and Madras, there is no marked line between Buildings and Roads and Irrigation, and there is a good deal of Irrigation, a slight preponderance is given to Imperial. For Bengal Buildings and Roads, only three Imperial charges are allowed, viz., for the Presidency Divisions and Under-Secretary; the Irrigation Establishment is equally divided between the two so as to give a good leaven of Imperial. For Buildings and Roads Branch in the North-Western Provinces, Punjab and Burma, there must probably be, for some considerable time a good proportion of Imperial men, and the charges are divided equally. For the purely Irrigation charges of the North-West Provinces and the Punjab, a slight preponderance is given to Imperial. The Buildings and Roads Charges of the smaller administration are assigned wholly to Provincial.

5. In fixing the total strength of the Imperial Establishment, it is necessary to provide that there should always be a sufficient number of Assistants in training for the Imperial Executive charges, the number of which is suggested in column D. It has long since been laid down as an axiom that this training in the Assistant class should not last more than 8 to 10 years, and to induce this rate of advancement the proportion of Assistant to Executive Engineers must be as 2 to 3. The total effective strength as in column F, and the distribution of the whole strength, including allowance for absentees, as in columns H and I, are deduced accordingly from the number of Executive Charges in column D by allowing the necessary proportion to induce this rate of promotion.

6. The balance of the establishment, according to the revised strength in column B, must be Provincial, and this establishment must fill the balance of Executive posts which remain after providing for the Imperial Establishment, and the rest must be Assistant Engineers. This is worked out in columns J to N. It will be observed that in the Provincial Establishment the Assistants greatly exceed the Executives, that is, we sacrifice the Provincial to the Imperial. It is reasonable that the rate of promotion in responsibility and pay (which depends on this distribution) for the Provincial Establishment should be slower than for the Imperial, but probably some device would be necessary to accelerate it.

7. The general result of the table, however, is that for these Provincial lists we require the following establishment of Executive and Assistant Engineers including allowances for absentees:—

	Executives.	Assistants.	Total.
Imperial	95	66	161
Provincial	126	213	339

8. There then remain the Railway and Military Works Department lists, the former of which, we may tentatively assume, must be manned wholly by Imperial Engineers, viz., Cooper's Hill and Royal Engineers, and the latter by Royal Engineers. If we assume that, irrespective of the charges held, they must be divided into Executive and Assistant classes in the proportion necessary to give the proper flow of promotion.

9. The actual present strength calculated for the Railway Branch is 145, and 52 for the Military Works Department; and adding 15 per cent. to each for absentees, the establishment will be—

	Executives.	Assistants.	Total.
Railway. ...	99	67	166
Military Works Department ...	36	24	60
and adding all the lists as above together, we get as the total strength of Executives and Assistant Engineers for India:—			
Imperial ...	230	157	387
Provincial ...	126	213	339
Grand Total ...	356	370	726

10. Next as to the superior posts above the rank of Executives and Assistants which may be taken as 80. The distribution by classes of lists for the posts may be taken as follows:—

Provincial lists—Buildings, Roads and Irrigation ...	46
Railway Branch ...	27
Military Works Department ...	7

And assuming, solely for purposes of establishing the strength, that these posts would fall to Imperial and Provincial in proportion to their strength in the several lists, we should have—

	Imperial.	Provincial.	Total.
Provincial Lists ...	15	31	46
Railway ...	27	—	27
Military Works Department ...	7	—	7
	49	31	80

or in round numbers 50 superior posts fall to Imperial, and 30 to Provincial.

11. Allowing again 15 per cent. for absentees in these posts, the strength for Imperial and Provincial would be—

	Executives and Assts.	Spr. Posts.	Total.
Imperial ...	387	58	445
Provincial ...	339	35	374
			819

12. Now the above total strength is not far off the number (800) to which our present rate of recruitment is understood to be leading us; but there is considerable difference in the distribution of the Imperial and Provincial element, which at present is as follows:—

	Recruits.	Ultimate Strength.
Imperial		
Cooper's Hill ...	15	400
Royal Engineers ...	6	160
Provincial		
Indian Colleges ...	9	240
	30	800

that is, instead of tending to an establishment of 430 Imperial and 370 Provincial, as approximately worked out above, we are tending to one of 560 Imperial, and 240 Provincial.

13. Again, if we take our present establishment of about 1,000 men, we find that it consists of 745 European Engineers, who answer to the Imperial, and of 255 Indian Engineers, who answer to the Provincial Establishment. If, then, we intend to take steps to remodel the establishment in the direction indicated, we must modify our rate of recruitment.

14. Our present rate of recruitment is confessedly a reduced one, the full rate being 33 for a strength of 880 men, and the reduction was obtained by decreasing the number of Royal Engineer recruits from 9 to 6. It will probably be considered inadvisable, under present circumstances, to increase the total recruitment; but in making any modification we should recruit (if we can) up to the full ultimate Royal Engineer strength of about 250, as arranged with the Military Department in communication with the Home Government. The revised recruitment and strength according to the accepted estimates would then be—

	Recruits.	Estimated Strength.
Imperial—		
Cooper's Hill ...	7	180
Royal Engineers ...	9	240
Provincial—		
Indian Colleges ...	14	370
	30	800

15. According to this proposal, Cooper's Hill, which began some years ago, with an annual number of 40 or 45 appointments to the Public Works Department, now reduced to 15, would come down to 7.

16. The above conclusions and proposals may be summed up as follows:—

1st.—That, at according to present estimates of strength and requirements of the different lists, we might work the Public Works Department with 430 Imperial (European) and 370 Provincial (Indian) Engineers

2nd.—That we should so organize the Imperial Establishment re-arranged under the first proposal as to give what is considered the essential rate of promotion in the Executive grades.

3rd.—That if we decide to take this step, we should considerably increase the Indian recruitment, and reduce the Cooper's Hill element.

17. It is assumed that the Local Governments will be content to supply their Provincial Service by recruits from the four Indian Colleges (Roorkee, Seelbore, Poona, Madras), but if any other source of recruitment is advocated, or if any change should be made in the system there pursued so as to provide a higher education for Provincial Engineers than they now get, its nature should be explained in the reply to this memorandum.



*Sub-head 2.—Rates of Pay and Promotions of the Provincial Establishment.*

18. The Provincial Establishment, according to the suggestions made above, will be organised on the following main lines :—

Superior posts	...	...	...	30
Executive posts	...	...	...	127
Assistants	...	...	...	213

370

The above ratio between Executives and Assistants would give promotion from one class to the other in about the 16th and 17th year of service.

19. Then as to the rate of pay for this establishment, the Public Service Commission recommends that it should be fixed without reference to that of the Imperial Establishment.

As we shall have to commence the establishment with a very few men all in the lower grades, and as it will gradually increase to a considerable strength under the influence of an increased number of recruits, it will probably be better to give an incremental scale; in fact the only alternative to this would be a graded scale adjusted periodically to give approximately the same rate of promotion as that which the incremental scale will give.

20. If the rate of pay of the Provincial Service is fixed on the same sort of scale as has hitherto been current, then the salaries of the Executive and Assistant grades might be as follows; but this is merely put forward as a suggestion on which to work, and because some definite proposals are required :—

	Period in grade.	Promotion possible at end of
Apprentice on Rs. 100	... 1 year	1st year.
Assistant Engineer Class,		
2nd grade, Rs. 125-25-250	... 5 years	6th year
1st do Rs. 275-25-400	... 5 "	11th "
Executive Engineer Class,		
2nd grade, Rs. 450-30-600	... 5 years	16th year
1st do Rs. 600-30-750	... 5 "	21st "
An increment of Rs. 50 after		
two years	... 2 "	23rd "
Do. of Rs. 50 do.	... 2 "	25th "

The maximum pay thus obtainable by men in the 1st grade of Executives would be Rs. 850, and they would attain this about the end of the 47th year of their age at the earliest, that is, after passing through the grades as fast as they could. The above arrangement of grades would distribute Executives and Assistant Engineers in about equal proportions, and would perpetuate the present anomaly of giving men the pay and rank of Executives, and the work of Assistants. If the ratio of 127 Executives to 213 Assistants, as in para. 18, is to be maintained, the period of service in the class of Assistant Engineer must be considerably enlarged; temporary promotions from class to class should be allowed only for change of duties.

21. It is probable, however, that some instructions of a general character may be issued by the Government of India regarding the scale of salaries to be allotted to the Provincial Service in all departments; and as the question of the pay of this branch of the Public Works Department does not press so urgently for a solution as does that of the number of posts to be set apart for them on which an early decision as to future recruitment depends, it may perhaps be convenient if an answer on this sub-head be deferred till the Government of India has declared its opinion on the general question.

22. It is possible, moreover, that Local Governments may hold that it is not necessary to create a new Provincial Service between the Imperial and the present Subordinate Service, but that all the work for which the Imperial Service is not required can be effectually performed by an enlargement of the upper ranks of the present Subordinate Service and without alteration of the present salaries. If this view is entertained, it is hoped that definite proposals as to the number, grades, and recruitment of this Upper Subordinate Service will be submitted in reply to this memorandum.

*Sub-head 3.—Whether the superior appointments are to be made on one scale of Pay, and open without distinction to Imperial and Provincial men*

23. Another question to be decided is whether the superior appointments above the Executive grade should carry the same pay, whether held by Provincial or Imperial men, and whether men of each establishment should be appointed by selection to these posts, or whether there should be any reservation of a proportionate share of the posts for each establishment.

24. It would be easier to allow a separate scale of pay for those posts if there were any prospects of working Provincial establishments without any admixture of Imperial men; for there may be some difficulty in making an Imperial Executive Engineer on Rs. 1,000 work under a Provincial Superintending Engineer on Rs. 900, or an Imperial Superintending Engineer on Rs. 1,600 under a Provincial Engineer on Rs. 1,500. It would be probably equally difficult to arrange that Provincial men shall only serve under Provincial, and Imperial men under Imperial, when men of both services are employed in the same branch.

25. This will be seen at once from the figures below, which are based on the supposition that the superior posts are divided between Imperial and Provincial men approximately according to the numerical proportion of each :—

	Chief Engineers.	Superintending Engineers.
Buildings and Roads Branch—		
Imperial	6	5
Provincial	2	21
Irrigation—		
Imperial	3	3
Provincial	0	6
	11	35

That is to say, in the Buildings and Roads Branch the bulk of the Superintending Engineer appointments would be held by Provincial men who would thus come in contact with Imperial men, while it would be difficult to prevent the Chief Engineers of the Provincial Establishment from being placed over Imperial men. In the Irrigation Branch, the Provincial and Imperial appointments would be about equally divided, and the Imperial men would generally hold the Chief Engineerships. On the whole, the probable conclusion seems to be that unless an establishment can be wholly worked by Provincial or by Imperial men, it will be simpler to have only one scale of pay for the superior appointments. This uniformity of pay is irrespective of the question whether a fixed proportion of the superior appointments should be given to Provincial men, or whether no proportion of the whole number of superior appointments dependent on the strength of each should be laid down for either establishment, but the best men should be selected from either class with due regard to the claims of seniority.

*Sub-head 4.—Distribution of the present establishment between Imperial and Provincial, and transition from the present to the new organisation.*

26. The present distribution of the establishment between European and Indian Engineers, which two classes are ultimately to correspond with the Imperial and Provincial, is as follows :—

	European.	Indian.	Total
Chief Engineers and officers ranking as such	... 24	...	24
Superintending Engineers and officers ranking as such	49	7	56
Executive Engineers	354	106	460
Assistant Engineers	318	142	460
	745	255	1,000
As compared with our ultimate scale of	430	370	800

It may be calculated roughly that if we alter the rate of recruitment, as suggested in para. 14, we should increase the Indian Establishment to the revised number of 370 by about the year 1905, and that similarly the European establishment would be considerably reduced by the same period, and would be approximating to the ultimate number.

27. The difficulty is when and where to start the Indian Establishment as a separate organisation to the European; when and where to draw the line.

28. The position is that we have now one establishment of European and Indian Engineers on one scale of pay, and we want to divide this establishment into two separate establishments, one of which will be on a lower scale of pay. It is also very desirable, in order to hasten the new organisation, that the separation should include some of the present establishment.

29. The problem is how to make this separation equitably. In the first place, the line between each class, the European and Indian Engineers, though clearly marked in the lower grades, which are filled by men recruited in definite proportions from Cooper's Hill and from Indian Colleges, is not so clearly marked in the upper grades; and the men in these upper grades would look upon it as a very great grievance and slur upon them to be placed in a class which must inevitably be looked upon as the inferior class. Some of them, though not a very large number, are men whose domicile is in England. It is therefore, irrespective of any question of altering the rate of pay of present incumbents, that none of the men now in the higher grades can be placed in the inferior service. It is suggested, however, that the line may be drawn below either the 3rd or the 4th grade of Executive Engineers, and, that all the Indian Engineers may be placed below this line in a separate list, which will be the commencement of our Provincial Establishment. All the men below the line with very few exceptions, if any, are Natives, Eurasians or Europeans whose domicile is in India.

30. It does not follow, however, that relegation to the inferior establishment must of necessity mean decrease of even prospective pay to all. The following compares the present rates common to the whole establishment with the rate proposed for the new class :—

	Present Scale.	Suggested Provincial.
Apprentice	Rs. 100	Rs. 100
Assistant Engineer, 4th grade	...	125
Do. 3rd do.	250	to
Do. 2nd do.	350 to 400	250
Do. 1st do.	500	275
Executive Engineer, 4th do.	600	to
Do. 3rd do.	700	450
Do. 2nd do.	800	to
Do. 1st do.	950	600
		to
		850

31. The proposal is that men below the present 3rd grade, that men on Rs. 600, Rs. 500, Rs. 350, Rs. 250, and Rs. 100 should pass over to the new Provincial Establishment; but to prevent inequitable reduction in their prospective pay, it might be provided that two additional increments of Rs. 50 each should be allowable to men of the present 4th grade Executive and 1st and 2nd grade Assistant so as to bring their pay ultimately up to Rs. 950. Meanwhile, all would pass into the new grades, that is, the 4th grade Executive Engineer, after completing five years on Rs. 600, would be eligible for promotion to the Rs. 600—850 grade, and by further periodic increments might rise to Rs. 950. Similarly the 1st grade Assistant would pass into the new Rs. 450—600 grade, and would receive increment, and be eligible for promotion in due course. The 2nd grade Assistant would pass into the Rs. 275—400 grade, and would rise on the same principle. The 3rd grade Assistant should be promoted to the Rs. 275—400 grade on the same conditions as they would have been promoted to the present 2nd grade on Rs. 350, and should then go on regularly through the new grades, but there is no need, it is thought, to give them increments beyond the new scale as in the case of the other two grades.



32. Summarising, the proposals are as follows:—

(1.) To place about 80 men of the 1st, 2nd and 3rd grades of Executives, notwithstanding that they are Indian Engineers, in the Imperial list of Engineers, and to place them on exactly the same footing as regards pay as the European Engineer. Their pensions to follow the same rules as now.

(2.) To place 23 4th grade Executives, 93 1st grade and 29 2nd grade Assistants, who are Indian Engineers, in the new Provincial List, but to allow them to draw up to Rs. 950 in the 1st grade.

(3.) To put 15 3rd grade Assistants and Apprentices wholly on the new rates of pay proposed for the Provincial Establishment, in other words to deal with them as with the recruits.

33. The effect of the above proposals would be to modify the immediate distribution of the Imperial and Provincial establishments as follows:—

	Imperial.	Provincial.	Total.
Chief Engineers and officers ranking as such	24	—	24
Superintending Engineers and officers ranking as such	56	—	56
Executive Engineers	437	23	460
Assistant Engineers	318	142	460
	835	165	1,000

Sub-head 5.—Whether the several lists can be worked as separate and independent services.

34. The Provincial Establishment being at present so small would have probably to be organised for some years to come as one list. Its distribution at the present moment, as compared with the ultimate Provincial Establishment estimated for each list as in table A, would be as follows:—

	Engineers 4th grade.	Assistants.	Total.	Ultimate Total.
Bombay	1	15	16	40
Madras	1	5	6	47
Bengal, Buildings and Roads	3	11	14	14
Do. Irrigation Branch	2	5	7	28
N. W. Provinces, Buildings and Roads	2	18	20	28
Do. Irrigation Branch	3	9	12	35
Punjab, Buildings and Roads	2	18	20	28
Do. Irrigation Branch	2	10	12	34
Burma	2	8	10	29
Assam	2	3	5	16
Rajputana and Central India	1	7	8	10
Hyderabad	2	2	4	18
Central Provinces	2	6	8	11
Coorg	1	1	2	1
Railways	19	115	134	339
	4	27	31	....
	23	142	165	339

35. It would be hardly possible, it is thought, with these small numbers to give each list a graded scale on which promotions might be made; but the scale of pay proposed would obviate many difficulties likely to arise on this score. Care would have to be taken, however, by the Central Authority, that is the Government of India, that the distribution of Executives and Assistants to each list should be reasonable.

36. Summarising again, the proposed organisation would be as follows for some years to come:—

1st.—An Imperial Establishment on separate lists as at present, consisting of all the present European and about 80 Indian Engineers. This list on the present rate of recruitment being a tared from 21 to 16 would gradually decrease from its present number of 835 to 430.

2nd.—A Provincial Establishment on one list, but under the control of the Local Government, on scale of pay fixed as suggested in para. 18.

37. Eventually, as the strength of the Imperial Establishment diminished, and that of the Provincial increased under the influence of the altered rate of recruitment, the Provincial List might be split up, and each list made over wholly to the Local Governments, while the Imperial Establishment should be consolidated into one list.

38. In the above proposals nothing has been said about the promotion of Upper Subordinates to the Provincial Establishment which has been recommended by the Commission (para. 96, Chapter X.) such promotions would perhaps not be numerous, and they would not materially affect the strength; in fact, at first they would probably be an assistance to the efficiency of the establishment. The men promoted would come to some suitable place in the Provincial scale, and would rise in it.

39. As regards furlough and pension, it will probably be held that each class of Engineers now in the department should retain the furlough and pension rules to which they are now liable; that is to say, those who are now classed as European Engineers, and have the more favorable leave and pension rules, or the pension rules only, as the case may be, will retain those rules intact. At the same time those Indian Engineers who, it is suggested, should be classed on special grounds as Imperial Engineers would retain their present rules, which are those of the Uncovenanted Service.

40. The rest of the Indian Engineers now in Government employ, whom we propose to class as Provincial, would retain their present rules—those, viz., of the Uncovenanted Service.

41. In regard, however, to the men to be hereafter recruited into the Provincial Establishment, the suggestions of Local Governments are invited as to whether they should be pensionable or not; and if pensionable, whether they should come under the present rules of the Uncovenanted Service or under modified rules; and lastly whether those who rise to the superior appointments should be eligible, as now, to the superior scale of pensions for European Engineers.

Provinces or List.	Revised strength exclusive of absentees.				Total number of Executive charges.				Distribution of charges.				Imperial strength from D.				Provincial Strength.			
	A.	B.	C.	G.	D.	E.	F.	G.	H.	I.	J.	K.	L.	M.	N.	O.	P.	Q.	R.	S.
Bombay	..	64	33	33	17	16	23	32	19	13	36	4	40	18	22	..	..	..	..	..
Madras	..	68	29	29	15	14	25	29	17	12	45	4	47	16	31	..	..	..	..	..
Bengal, Buildings and Roads	..	18	9	9	8	6	6	6	4	2	18	1	14	7	7	..	..	..	..	..
Do. Irrigation Branch	..	37	14	14	7	7	12	14	8	6	25	3	28	8	20	..	..	..	..	..
North-Western Provinces, Buildings and Roads	..	38	10	10	5	5	8	9	5	4	25	3	28	6	22	..	..	..	..	..
Do. Irrigation Branch	..	47	16	16	9	7	15	17	10	7	32	3	35	8	27	..	..	..	..	..
Punjab, Buildings and Roads	..	40	18	18	9	9	15	17	10	7	25	3	28	10	18	..	..	..	..	..
Do. Irrigation Branch	..	46	17	17	9	8	15	17	10	7	31	3	34	9	25	..	..	..	..	..
Burma	..	43	20	20	0	10	17	20	12	8	26	3	29	11	13	..	..	..	..	..
Assam	..	13	11	11	..	11	..	..	..	..	13	2	15	12	3	..	..	..	..	..
Rajputana and Central India	..	9	4	4	..	4	..	..	..	..	9	1	10	5	5	..	..	..	..	..
Hyderabad	..	16	7	7	..	7	..	..	..	..	16	2	18	8	10	..	..	..	..	..
Central Provinces	..	11	6	6	..	6	..	..	..	..	11	1	12	7	5	..	..	..	..	..
Coorg	..	1	1	1	..	1	..	..	..	..	1	..	1	1	..	..	..	..	..	..
Total Mixed List	..	446	196	196	84	111	140	161	95	68	806	33	839	126	213	..	..	..	..	..

Order—dated 21st July 1888, No. 2223 W., Public Works.  
Ordered that the following reply be sent:—

(True Extract.)  
(Sd.) J. O. HASTED, COL., R.E.,  
Secy. to Govt., P. W. D.

To the Secretary to the Government of India, Public Works Department, dated Ootacamund, 21st July, No. 2224 W.

With reference to your letter No. 1432 G., dated 15th June 1888, I am instructed to offer the following observations referring in succession to the sub-heads into which the "Scheme for a separate Imperial and Provincial Establishment, Public Works Department" submitted with your letter is divided:—

Sub-head 1.—Including the lately formed new division in the Kistna and the temporary divisions of Rushikulya, Ramnad and Periyar, there are 30 divisions in the Madras Presidency; the Ramnad Division will, however, be abolished next year, leaving 29 divisions, which agrees with the number given in the statement accompanying the scheme, two of these probably being retained for the next five years only. The utmost care has been taken in distributing the divisions between Imperial and Provincial, and the accompanying statement gives the result finally determined. With the exception of the Nilgiris, all the divisions classed as Imperial, contain either very important irrigation works or large military buildings, and in some cases both, and it would be objectionable, in the opinion of this Government, to entrust their charge to officers of the Provincial Service—on the Nilgiris there are Government House and Military Headquarters, and there are other obvious reasons why this station should be kept for officers recruited in England. The Buckingham Canal has been classed as Provincial, but until the completion estimates are worked out, it must be an Imperial Charge. Madras must become an Imperial Charge when the Periyar Project is completed and absorbed in it, but by that time there will probably be some other temporary division, and possibly there may be some Provincial Officer competent to hold one of the charges now classed as Imperial. This Government will certainly do their best to provide for the Provincial men: The figure in D column of table A, from which the figures in subsequent columns are deduced, is therefore 20 instead of 15.

This Government concurs in the view that Assistant Engineers in the Imperial Class should be promoted to Executives in 8 or 10 years at



latest, but they are of opinion that Assistants in the Provincial Class should attain their promotion before they are 16 years in the service; otherwise, in many instances, a man will be past his prime before he is promoted, and an Executive Engineer should possess considerable energy and activity. As regards the source from which the Provincial Service should be recruited, this Government are of opinion that, as a rule, Assistant Engineers should be obtained from the Civil Engineering Colleges in India, but that, in special cases, it will be advisable to promote from the subordinate grade. They are of opinion, however, that in view of the present facilities for travelling in India considerable economy may be effected by confining the higher education necessary for Provincial Engineers to a single College in India, and they would suggest Poona, being the most centrally situated, as its most convenient location. The other colleges would then be restricted to the course of education necessary for admission to the Upper Subordinate grades.

*Sub-head 2.*—As regards the rates of pay and promotion of the Provincial Establishment, this Government are of opinion that the pay of Assistant Engineers and Executive Engineers may be fixed without reference to that of the Imperial Establishment, but that the scale given in para. 20 of the "Scheme" commences too low, with the exception of the Apprentice grades, which, it is presumed, corresponds with that of men under practical training; and the system of yearly increments does not commend itself to them. If, as suggested above, Upper Subordinates are, in special cases, to be promoted as Engineers, the grade from which they would be promoted would probably be that of Supervisor, 1st grade, which would contain men of considerable experience, and yet not too old for advancement, and in that case the pay of Assistant Engineer, 2nd grade, must be at least equal to that of Supervisor, 1st grade. If yearly increments are given, the pay might commence at Rs. 200, but if, as this Government would prefer, no increments are given, the pay of Assistant Engineer, 2nd grade, should be Rs. 250. An Assistant Engineer, 1st grade, would then receive Rs. 350, and there might be four grades of Executive Engineers, each step of promotion giving an increase in pay of Rs. 100.

After two years in the highest grade an addition of Rs. 50 might be made, and after another two years a further addition of Rs. 50 as suggested.

*Sub-head 3.*—The superior appointments above the grade of Executive Engineer are always made by this Government by selection, and this being the case, the Government are of opinion that these appointments should be open without distinction to men on Imperial and Provincial lists, and that there should be one scale of pay for them.

*Sub-head 4.*—Without interfering with the prospects of men who entered the service with certain expectations, it will be extremely difficult to effect the transition to the new organisation. To those, however, who have lately entered the service, the prospect of some reduction has not probably appeared uncertain. This Government are therefore of opinion that the pay above the rank of Assistant Engineer on the Provincial Service might be fixed on the new scale, and that there is no reason why the Provincial should not be at once separated from the Imperial List, so long as present incumbents in grades above Assistant Engineer are secured the present scale of pay up to date of retirement.

*Sub-head 5.*—The suggestion in the scheme is apparently to form an amalgamated Provincial List, which would be retained while the numbers on the list are small, but when the numbers are much increased to split it up, making over the portions to the Provincial Governments, while the Imperial Lists which would then be reduced should be amalgamated. On the subject of amalgamating the Imperial lists, this Government has already expressed an opinion in letter No 3391 W., dated 12th December 1887, and they are willing to defer further consideration of the subject until the Imperial lists are very considerably reduced; but they are of opinion that it will be best in every way to start and continue the Provincial Establishment under the Provincial Governments, who would work it as one list with the existing Imperial Establishment.

As regards the question whether the men on the Provincial Establishment should be pensionable or not, this Government entertain no doubt that they must receive pensions, and that the rules of the Uncoovenanted Service should apply to them.

2. In the above the questions asked in paras. 2 to 7 of your letter under reply have been answered, with the exception of that in the latter part of para. 4, with respect to which I am to say, that this Government inclines to the opinion that, for some time to come at all events, the Engineers of the Railway Branch should be wholly Imperial. There are, however, only three, the Consulting Engineer and two Deputies, under this Government.

(Sd.) J. O. HASTED, R.E.,  
Secy to Government., P. W. D.

IMPERIAL.			PROVINCIAL.		
	Divisions.			Divisions.	
Godavari	...	3	Gangam	...	1
Kistna	...	3	Vizagapatam	...	1
Nellore	...	1	Cuddapah	...	1
Rushikulya	...	1	Kurnool	...	1
Bellary	...	1	Trichinopoly	...	1
West Coast	...	1	Madura	...	1
Periyar	...	1	Tinnevely	...	1
Nilgiris	...	1	Buckingham Canal	...	1
North Arcot	...	1	Coimbatore	...	1
South Arcot	...	1			
Chin-leput	...	1			
Presidency	...	1			
Presidency Workshops	...	1			
Tanjore	...	1			
Negapatam	...	1			
Consulting Architect	...	1			
Total	...	20	Total	...	9

## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

Burma, September 29, 1888.

Mr. W. R. Foy, Assistant Engineer, 1st grade, is transferred from the 2nd Circle to the 1st Circle for employment in the Henzada Division.

Mr. J. Donnan, Assistant Engineer, 1st grade, Myngyan Division, 2nd Circle, is granted two months' privilege leave, with effect from the forenoon of the 1st October 1888. This cancels *Burma Gazette* Public Works Department Notification, dated the 21st June 1888.

Major M. Laugharne, R.E., Executive Engineer, 2nd grade, Public Works Department, Burma, on duty at Chatham, is granted 11 months' furlough from the 1st December 1888, or from such date as he may complete his course of instruction at Chatham.

Madras, October 2, 1888.

The following reversion and promotions are made:—

Mr. J. J. Whiteley, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, permanent rank, with effect from 23rd August 1888.

Mr. J. J. Whiteley, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 15th September 1888.

M. R. Ry. R. A. Srinivasa Aiyangar, Rai Sahib, B.A., B.C.E., from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, *sub-pro tem.*, with effect from 15th September, 1888.

Punjab, October 4, 1888.

Lieutenant R. S. MacLagan, R.E., Assistant Engineer, 1st grade, was placed in charge of the current duties of the Executive Engineer, Dera Ghazi Khan Provincial Division, in addition to his own, with effect from the 5th August 1888, *vice* Mr. Campion, on privilege leave.

#### Irrigation Branch.

Mr. E. S. Bellasis, Executive Engineer, 3rd grade, from the Karnal Division, Western Jumna Canal, which he left on the forenoon of the 4th September 1888, to the Patiala Division, Sirhind Canal, which he joined on the forenoon of the same date. Mr. Bellasis took over charge of the Patiala Division and the Canal Agency Office, Sirhind Canal, from Mr. J. T. Farrant, Executive Engineer, 4th grade, temporary rank, on the forenoon of the 5th September 1888.

Mr. J. J. Mullaly, Executive Engineer, 2nd grade, from the Chenab Canal Division, which he left on the afternoon of the 31st August 1888, to the 1st Division, Bari Doab Canal, which he joined on the forenoon of the 1st September 1888.

Mr. P. S. McGowan, Executive Engineer, 3rd grade, took over executive charge of the Lower Sutlej and Chenab Division, Inundation Canals, from Mr. E. A. Sibold, Executive Engineer, 1st grade, on the afternoon of the 5th September 1888, and the latter officer proceeded on the one month's privilege leave granted in Irrigation Branch Memo, dated 31st August 1888, on the afternoon of the same date.

N.-W. P. and Oudh, October 6, 1888.

#### Irrigation Branch.

Mr. G. T. Anthony, Assistant Engineer, 1st grade, Aligarh Division, Ganges Canal, is, on return from privilege leave, appointed to the charge of the Aligarh Division, Ganges Canal, during the absence of Mr. R. A. Corder, Executive Engineer, on privilege leave, or until further orders.

Mr. C. H. Hutton, Assistant Engineer, 1st grade, Mainpuri Division, Lower Ganges Canal, passed the Departmental Standard Examination in Hindustani on the 9th September 1888.

#### Buildings and Roads Branch.

Mr. S. J. Simpson, Executive Engineer, 4th grade, is transferred from the Etawah to the Gorakhpur district as District Engineer, *vice* Mr. G. E. Barnardo, granted special leave.

Mr. A. H. Ashton, Assistant Engineer, 1st grade, is appointed District Engineer, Etawah, *vice* Mr. S. J. Simpson.

India, October 6, 1888.

Major W. H. Coaker, R.E., Executive Engineer, 1st grade, Deputy Consulting Engineer for Railways, Madras, is transferred to the Superior Revenue Establishment of State Railways, in Class I, grade 3, *sub. pro tem.*, as Deputy Manager, North-Western Railway.

Colonel K. A. Jopp, R.E., Executive Engineer, 1st grade, Deputy Consulting Engineer for Railways, Calcutta, is appointed Deputy Consulting Engineer for Railways, Madras.

Lieutenant Colonel J. A. Little, s.c., Executive Engineer, 1st grade, North-Western Railway, is appointed to officiate as Deputy Consulting Engineer for Railways, Calcutta.

The services of the Honorable L. M. St. Clair, Executive Engineer, 3rd grade, are placed temporarily at the disposal of the Government of the Punjab, with effect from 1st November. This cancels Public Work Department Notification dated 23rd March 1888.



With reference to Public Works Department Notifications dated the 17th and 22nd September, 1888, the services of Mr. R. N. Hodges, Executive Engineer, 2nd grade, State Railways, are placed at the disposal of the Government of Bengal.

*Director-General of Railways.*

Mr. R. R. Gales, Assistant Engineer, 2nd grade, is transferred, in the interests of the public service, from the Bannu Railway Survey to the North-Western Railway.

**Central Provinces, October 6, 1888.**

With reference to Notification, dated 27th ultimo, Mr. R. B. Thomson, Executive Engineer, made over charge of the Jubbulpore Division to Mr. H. L. Cleaver, Assistant Engineer, on the afternoon of the 30th idem.

**Bengal, October 10, 1888.**

With reference to this Department Notification, dated the 6th ultimo, Mr. W. H. Rushton, Assistant Engineer, reported his arrival at Calcutta on the forenoon of the 6th instant on return from Beluchistan.

Lieutenant E. W. Walton, R.E., Assistant Engineer, first grade, Tirhoot State Railway, is granted language leave for three months, with effect from the forenoon of the 28th September 1888.

With reference to Government of India, Public Works Department Notification of the 5th October 1888, Mr. R. N. Hodges, Executive Engineer, 2nd grade, is posted to the Western Bengal Railway Survey.

With reference to Government of India, Public Works Department Notification, dated 25th September 1888, the undermentioned Executive and Assistant Engineers are posted to the Western Bengal Railway Survey.

Mr. A. B. Addis	Executive Engineer, 1st grade, sub. <i>pro tem</i> .
" P. P. Dease	Ditto 2nd grade.
" H. J. Oddie	Ditto 3rd grade, sub. <i>pro tem</i> .
" A. Bewley	Assistant Engineers, 1st grade.
" A. Morse	
" F. J. Pope	
Babu Siva Datta Pandey, Rai Sahib	
Mr. J. Woodside	Ditto 2nd grade.
" F. D. Couchman	

*Irrigation Branch.*

Mr. K. H. Stephen is appointed to officiate as Executive Engineer of the Arrah Division, during the absence, on privilege leave, of Mr. W. A. Inglis, or until further orders.

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## RECORDS

OF

## THE GEOLOGICAL SURVEY OF INDIA.

Vol. XXI., Part 3.

1888.

## CONTENTS.

*The Manganese-iron and Manganese-ores of Jabalpur, by PRAMATHA NATH BOSE, B.Sc., F.G.S., Deputy Superintendent, Geological Survey of India. (With 2 Maps.)*

*"The Carboniferous Glacial Period," by Oberberggrath Prof. DR. W. WAAGEN. Translated by R. BRUCE FOOTE, F.G.S., Superintendent, Geological Survey of India, (With one plate.)*

*The Sequence and correlation of the Pre-Tertiary Sedimentary formation of the Simla Region of the Lower Himalayas, by R. D. OLDHAM, A.R.S.M., F.G.S., Deputy Superintendent, Geological Survey of India.*

The "Records" are issued quarterly, in February, May, August, and November; the annual subscription, including postage, being Rs. 2-8. They contain brief reports and papers; abstracts of more detailed work, notices of the recent discoveries, donations to Museum, and accessions to Library, &c. The following have been published:—

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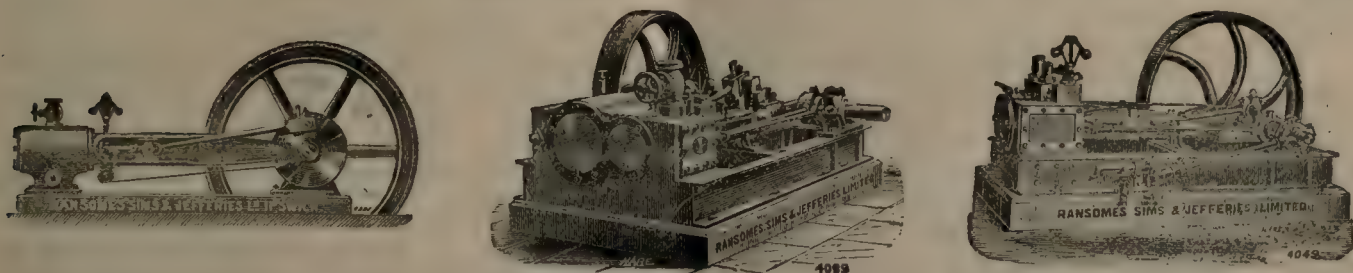
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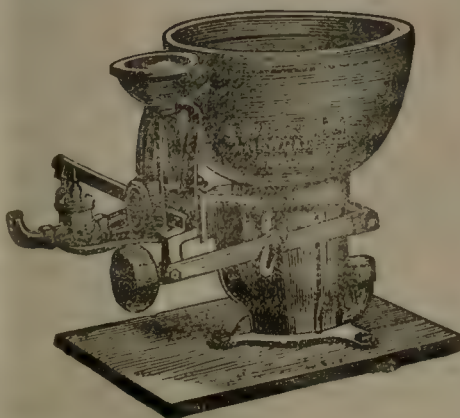
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Interest ...	£ 19,612 0 0	Interest and Dividends ...	£ 45,649 0 0	Interest ...	£ 8,294 0 0
Losses after deducting Re-insurances ...	£443,587 0 0	Claims less Re-insurances, ...	£ 79,229 0 0	Losses after deducting Re-insurances ...	£138,365 0 0
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The Life Fund was increased during the year by £65,648 and now amounts to £1,070,064.

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# INDIAN ENGINEERING.

SATURDAY, OCTOBER 20, 1888.

## UNCOVENANTED GRIEVANCES.

"It may be well to premise that at the root of this agitation lies the ever-diminishing rupee." So writes Mr. Buckley, C.E., in an able, closely-argued article on *The Uncovenanted Service Question*, which appears in the October number of the *Calcutta Review*.

The agitation referred to is the one being carried to Parliament by Mr. H. S. King in London, and which was vigorously carried on last cold weather by various gentlemen, in Calcutta, Madras, Lahore, Allahabad, Rangoon, and other places. It asks of Government the following concessions :—

- (I.) That officers who occupy the same position in any service (Schedule A of Civil Leave Code) should be treated equally as regards leave and pension.
- (II.) That the right to count actual service before the age of twenty-two as qualifying for pension should be conceded to all.
- (III.) That the obligatory period of service for pension should be reduced from 30 to 25 years.
- (IV.) That certain periods of furlough should be allowed to count as service for pension.
- (V.) That the pensions of officers retiring to their homes in Europe and the Colonies be paid at the rate of two shillings to the rupee.

The last is far and away the most important of these plaints; and is the one now welding together all the Uncovenanted Services to united action. The unprincipled rupee is a stumbling block and a motive power in many and diverse directions.

Covenanted Service pensions are paid in sterling. Reasonable expectations of being paid in like manner were raised in the minds of Uncovenanted men by the Home Government, from time to time.

The expressions "£400" and "£500" were used in all the earlier Rules and Despatches from the India Office dealing with the matter of Uncovenanted pensions.

Even in 1875, when the rupee had so far fallen away from grace that it had lost twopence in value, and was worth 1s. 10d. instead of two shillings, one of the Cooper's Hill College prospectuses set forth that "10 rupees are nearly equal in value to £1." Again, this *quasi* State paper quoted a salary of Rs. 4,200 per annum as "about £420," and Rs. 3,000 as "about £300." In some Telegraph Officers' Covenants the following passage occurs :—"And it is agreed that in all Payments to be made under these Presents the Pound Sterling shall be considered equal to and calculated after the Rate of Ten Rupees." In short, as Mr. Buckley puts it, "the use of the symbol £ was held as the equivalent of ten rupees, that is to the symbol Rx., which has lately been introduced, and a vast number of instances might be brought forward to shew that sums of Indian money were expressed under the symbol £, where no idea was enter-



tained of a distinct reference to the pound sterling as opposed to ten rupees."

The Uncovenanted contend that all pensions are of the nature of deferred pay, and that deductions have been made from Uncovenanted men's pay, with view to their being ultimately returned in the shape of pensions, quite irrespective of market rates of exchange. Some men were thus mulcted when the value of the rupee was two shillings—and yet in return they are only to receive at the rate of 1s. 4d., perhaps a year or two hence only at the rate of one shilling. This is unfair on the face of it. The more so since the Covenanted officer gets all his rupees back again at the rate of two shillings—even those which he deposited at 1s. 4d.

Another argument adduced in favor of the payment of Uncovenanted officers' pensions in sterling is that no sound reason exists why some of the European servants of the Crown should be paid in sterling, and others in a different currency. The *Saturday Review* says:—"It amounts to this—why should John, who goes into the Indian Civil Service be better treated as to furlough and pension than his cousin Thomas, who goes into the Public Works Department, from Cooper's Hill." As Mr. Buckley puts it:—"They admit that services vary in importance, and that the rates of salary and rates of pension may equitably vary, but that whatever reasons may be assigned for payment of the pensions of Covenanted Civilians, High Court Judges, or of Military Officers, in sterling, are equally applicable to the pensions of those officers of the Uncovenanted Services who, like them, have European training, have European modes of thought and of life, and who ultimately retire to Europe. The argument is based on the broad theory that the Service of the country in all its branches can be, in many respects, efficiently performed by the domiciled European or Eurasian, or by the native gentleman: but that it is essential that there should be in all Departments a leaven of European knowledge, thought, and energy: that this extraneous and imported labor, like imported wares of all kinds, must necessarily be valued in the currency of the country of its origin, and not of that to which it is imported: that while such imported servants may be willing to receive, in India, a portion of their price in Indian currency, they may fairly demand the final settlement of the account to be made, as the accounts of all imported articles ultimately are, in the currency of the country from which they came."

Of course, an important element in the question as to whether pensions should be paid at the rate of two shillings per rupee as originally intended and agreed, or at some arbitrarily fluctuating rate is the cost to Imperial Revenues if the former standard were adopted. Actual annual payments made in England during the five years from 1882 to 1887, on account of Uncovenanted pensions, averaged about £78,000, and this amount would have been increased by about £20,000 had the pensions been paid at the rate of two shillings to the rupee instead of at the official rate of exchange. Not a large sum for a great nation to pay by way of fulfilling its

agreements, and for the prevention of discontent amongst useful, well-deserving servants! £20,000 is Mr. H. S. King's estimate of the cost of the concession. Mr. Buckley thinks this an under estimate, and goes into figures to prove his contention that acceptance of the two shilling rate would entail an extra payment of £67,000—or say Rs. 10,00,000 a year. Even if we accept this figure as more correct than Mr. King's, it by no means represents too high a figure for the Imperial Government to pay, in order that it may not break faith, in order that faithful servants may not have legitimate cause for dissatisfaction.

Every unbiassed mind must, we think, agree with Mr. Buckley that, taking a broad review of the whole question, it seems impossible to deny that the claims of European Uncovenanted officers for some concession in the direction of sterling pensions are equitable. He contends that Sir John Gorst practically admitted this when he said that "in recent times several branches of the service \* \* \* \* had had enhanced pensions granted to them, *because of the fall in Exchange*." Thereupon our Reviewer pertinently enough comments:—"If a fall in exchange justifies the increase of the rupee pensions of one branch of the Service, it must justify it in all, when the other conditions are the same."

We have but skimmed the surface of Mr. Buckley's very able article. "Uncovenanted" readers cannot do better than procure for themselves a copy of it, and enjoy his argument *in extenso*.

#### THE CEYLON RAILWAYS.

"THEY do these things better in Ceylon," were the words that involuntarily rose to our lips, on perusing the report of the Ceylon Railways for the year 1887. That tight little island seems to manage its affairs in a truly economical spirit, consistent with efficiency. There is no meddling or muddling in its industrial enterprises; whether this is due to its being a colony under the direct supervision of the Crown, or to innate business qualities in the administration, we are not in a position to state definitely. Be that as it may, the results are very encouraging, and the managers of some of the Railway lines in India might, with profit to themselves and the public, take a leaf out of the book of our immediate neighbour. In this country reduction means an increase of expenditure, for while the duffry, bhiste, or the sweeper suffers, the top of the list gains by retrenchment, but Ceylon shews a cleaner and healthier bill of accounts in this respect. Since the re-organization in the Railway management in 1885 there has been a steady decline in the proportion of the working expenses to the receipts, which shews on what a sound basis the re-organization was conducted, and how harmoniously the various officers have been working which has contributed to the success of the department.

The general results of the year's working are as follows:—Receipts Rs. 29,47,628; expenditure Rs. 14,66,001; net profit Rs. 14,81,627. Compared with the previous



year, it shews an increase in receipts of Rs. 2,59,753; in expenditure of Rs. 14,285; and in net profit of Rs. 2,45,468. The debt on the Railway for outstanding capital cost of construction on 1st January 1887 was Rs. 1,51,42,588; the profit on the working for the year ending 31st December was Rs. 14,81,625, being 9.78 per cent. on the outstanding capital. The working expenses have been reduced from 54 per cent. of the receipts in 1886 to 49.7 per cent. In coaching traffic there has been an increase in the receipts of Rs. 93,289, due to an increase in the number of passengers of all classes, but more especially of the third and cooly classes. In the goods traffic there has been a net increase of Rs. 1,65,190 from tea, rice, first-class goods, second-class goods, arrack and manure, while on the other hand under the heads of coffee, cinchona, and cocoanuts, a decrease is indicated. As regards the expenditure, the working expenses of the Traffic Department amount to Rs. 3,35,700, or Rs. 21,830 over last year, a very small increase indeed, considering that 1,47,771 additional ordinary passengers, 406 additional season-ticket holders, and 5,861 additional tons of goods were carried. The expenditure of the Maintenance Department is Rs. 3,67,709 or Rs. 5,987 less than last year, notwithstanding that there was an extra relaying of 200 tons of steel rails.

All the lines did remarkably well, with the solitary exception of the Matale, which has been worked at a loss of about Rs. 8,900, but as it is a feeder to the main line, this small loss will hardly affect the question of increase, especially when it is borne in mind that the increase of Rs. 1,29,041 in receipts, and a decrease of Rs. 37,650 in working expenses is due to the traffic thrown upon the main line by the Nanuoya and Matale sections, while they have had to bear their proportion of the working expenses. Then there is another fact to be considered. The Matale line has been reviving during the period under review; there was an increase of 33,909 passengers, and 812 tons in the goods traffic; besides which the receipts have gone up by Rs. 6,054 over the previous year, while the working expenses have also gone down. The General Manager, Mr. Pearce, looks forward hopefully to the future, and gives the assurance that this is the last year of its loss.

But the most successful enterprise has been the Nanuoya extension; by the opening of this section traffic has increased by leaps and bounds beyond the most sanguine expectations. It shews an increase on receipts of Rs. 74,715, and taking into consideration that this is the most distant section of the Railway, and that the traffic which it commands must pass over another branch and the main line, any addition to the traffic must necessarily benefit the other lines. It is therefore no wonder that the Nanuoya extension has been the medium of increasing the receipts of this year by Rs. 2,22,161 over the last. Taking it by itself, and comparing with the outturn last year, we find that there was an increase in passengers over last year of 16,048 and in goods 11,316 tons, a highly satisfactory result.

We now come to the Blackwater slip; down to the end of 1886 the expenditure came to Rs. 61,96,297, and in

1887 to Rs. 29,38,671, making a total of Rs. 91,34,968.\* As a set-off to this the extra transport charges levied on goods passing this slip realised Rs. 27,253, and the sale of material used on the slip brought in Rs. 866, which gives a total slightly exceeding Rs. 28,000. While on the subject of Railways we may as well notice here that the extension of the line from Nanuoya to Haputale, a distance of 20 miles, has been decided upon by Government, and will be undertaken departmentally instead of on "the contract system." A Ceylon contemporary takes exception to this. He points out what experience has hitherto shewn that the Government agency employed has been unsatisfactory; and points for example to the accounts of the Nanuoya extension, which had not been published even at the end of the year 1887, and what guarantee have the public that the highly-paid officials will deviate from their course in the present instance. There is a great deal of truth in what the *Times of Ceylon* says on the subject.

#### THE GOVERNMENT OF INDIA ON ITS EDUCATIONAL POLICY, AND THE STRAIGHT WAYS INTO WHICH IT HAS BEEN DIRECTED.

IN the penultimate days of his reign in India, and with an eye to glorification of its bygone days, Lord Dufferin has been delivered of a Review of his educational policy and its products. Sir Alfred Croft and Mr. A. P. Macdonnell, C.I.E., stand sponsors for this State paper, and their names are a guarantee that it is exhaustive as well as concise. Writing as we do for an Engineering and cognately allied public, we need not concern ourselves here with the ramifications of Primary, Secondary, Higher, and Female Education. Let us see rather what is the Viceregal view on subjects affecting the professions we have the honor to represent. His Lordship comprises Engineering in the highest division of the Indian educational system; and we are told that while in 1881-82 there were three Engineering Colleges with 330 students, five years afterwards there were four, with 474 students. The Collegiate history of the reign is officially held therefore to be, "from a statistical point of view, one of progressive development." We plead guilty to a preference for the Engineering and Surveying School statistics that follow, and about the progressive development of which nothing is said. Nine of these Institutions were in existence in 1881-82 with 310 pupils: last year there were fourteen, with 616 pupils.

Technical education, we are told, has been brought into prominence (under Lord Dufferin's august auspices, *bien entendu*) by the pressure of two sets of considerations, which, though cognate, are not identical.

The first—divested of Departmental verbiage—pressure brought to bear on Government by the Secretary of State for India. This pressure is styled a "recommendation," and was, it is suggested, wanting in precision. So, the young lions of the Secretariat amended it, made it ship shape, set

\* Credit has been taken for Rs. 7,92,333, value of tools, &c., which remained in hand after the completion of the work.



it in working order. The second class of considerations these young lions had to manipulate related to the need for industrial occupations that is felt—or that ought to be felt—by a population rapidly outgrowing the means of support supplied by a too conservative system of agriculture. Likewise with the need for scientific methods of developing the material resources of India, and improving its products and manufactures, so that it may be better able to hold its place in the markets of the world “where competition is carried on with an intensity of purpose, which has been compared to the conditions of warfare.” These views fit in admirably with our preachments on the subjects for a long time past. The para, following the one dealing with the second set of considerations postulated is such an excellent sample of pedagogic priggishness that we should not feel justified in withholding it from our readers. Thus it runs:—“Technical education proper is the preparation of a man to take part in producing efficiently some special article of commercial demand. It is the cultivation of the intelligence, ingenuity, taste, observation and manipulative skill of those employed in industrial production, so that they may produce more efficiently. And thus technical education of the special, as contradistinguished from the preparatory, kind is an auxiliary of manufacture and industrial capital. In India at the present time the application of capital to industry has not been developed to the extent which in European countries has rendered the establishment of technical schools on a large scale an essential requisite of success. But the extension of Railways, introduction of mills and factories, the exploration of mineral and other products, the expansion of external trade, and the enlarged intercourse with foreign markets, *ought* in time to lead to the same results in India as in other countries, and create a demand for skilled labor and for educated foremen, supervisors, and managers. It may be conceded that the effect of these various influences on an Asiatic people is very gradual, and that it would be premature to establish technical schools on such a scale as in European countries, and thereby aggravate the present difficulties, by adding to the educated unemployed a new class of professional men for whom there is no commercial demand. Still, a large field is open for the action of Government and public liberality in the direction of promoting special technical education suitable to the immediate requirements of the country and capable of expansion with its growing necessities.”

We are responsible for the italics in this quotation. There *ought* to be very many things in this world that there are not, and that in all probability there never will be. *Ought*, in this instance, means falling back on the faith in the omnipotency of the respectable economical adage that demand creates supply; means inability to understand that the east is not as the west; that economic laws applicable to the busy, bustling, energetic, railroad permeated world over seas are not necessarily applicable, not even often applicable to the lazy, *laissez faire*, railroad deficient orient.

We are almost tired, almost ashamed, of repeating this

obvious truth. But we feel in duty bound to go on repeating it till some sense of its truth is dinned into official obtuseness; and we hope our readers will recognize the necessity and let it be sufficient apology for such “vile reiteration.”

The young lions of the Secretariat, using Lord Dufferin as a mouthpiece, with view to the promotion of technical industries, advise that technical workshops should be established in the neighbourhood of large Railway workshops. As if large Railway workshops were not already, in themselves, more apt and efficient training schools of the sort indicated than any that Secretariat ideas could devise! *Ought* it not to occur to these callow educational authorities that, as the homely proverb puts it—’tis no use sending coals to Newcastle? It seems to us, moreover, that what is wanted is diffusion throughout the country, as far as may be possible, of opportunities for its unemployed young men to secure technical instruction; not limitation of such opportunities to certain unduly favored localities.

We note a suggestion by His Excellency in Council that, in every province of the Empire, “an Industrial Survey should be completed.” We don’t quite know what is meant by this; but can see no reason to suppose that any harm could be done if it were carried into the region of fact, supposing that to be possible in the teeth of interloper objections to an inquisition into their private affairs. Furthermore, His Excellency in Council suggests formation, in the provinces of a Committee of educational experts to supervise and advise about appropriate means of technical education.

In India, when affairs come to the Committee stage they must be in a very bad way indeed; may be adjudged moribund without further parley. We take it that this Viceregal deliverance we have been commenting on is still-born. It has exalted Lord Dufferin’s horn of righteousness, and so has effected the purpose for which it was designed. That suffices for him and the Secretariat. Incidental confirmation of this surmise may be found in the fact that the ordinary, everyday working of the scheme has been, to all intents and purposes, relegated to the Etcetera Department. *Vide* conclusion of para. 25. Verily once more, in the world’s history, *parturiunt montes, nascitur ridiculus mus*.

In the United States there is about one million of people employed on the Railways.

COMMUNICATION by telegraph with Australia has now been restored, the cable between Banjoewanjie and Port Darwin having been repaired.

THE preliminary surveys for the construction of the Siberian Railway have now been completed as far as Irkutsk, and it is expected that half the line will be marked out before the winter sets in.

THE total value of minerals raised in the United Kingdom in the year 1887 according to the official returns was £55,326,164, and in the year 1886 the value was £55,010,231. Of metal obtainable from ores by smelting, the average market value in the year 1887 was £12,997,847, and in 1885 it was £12,848,739.



## Notes and Comments.

**THE NATIVE ARTS EXHIBITION.**—The Poona Exhibition of Native Arts and Manufactures is a complete success.

**IS THIS TRUE?**—A contemporary observes that "Sub-Engineers rise to the second and first grades after fifteen-and-half and nineteen-and-half years."

**PROPOSED NAINI TAL RAILWAY.**—The surveys for this project are now well advanced, and have not yet revealed any obstacles but such as are common to all hill railways.

**BURRAKUR SANDSTONE.**—A consignment of this well known sandstone was recently shipped from Calcutta for the Synthya Bridge on the Toungoo-Mandalay extension, Burma State Railway.

**A FAMINE RAILWAY SANCTIONED.**—It is announced that the sanction of the Secretary of State has been received for the commencement of the Tripetty-Vellupuram famine line on the Madras side.

**THE IRRAWADDY FLOTILLA.**—Mr. James Oswald, late of the Cranstonhill Foundry, Glasgow, has been appointed Manager of the Irrawaddy Flotilla Company's iron and brass foundries, at Dalla, near Rangoon.

**THE PUBLIC SERVICE COMMISSION AND P. W. D. RE-ORGANIZATION.**—The Official Papers published by us in last issue are important, as they make known for the first time the real intentions of the Government of India in respect to the Public Works Staff.

**"THE LARGEST LOCOMOTIVE STATION IN THE EAST."**—We are informed, with reference to our paragraph on this head, that Crewe could shew a greater record than 120 *working* engines, but that would not pertain to a single company, as in the case of the E. I. R.

**HONG-KONG PEAK TRAMWAY.**—We hear that Mr. W. K. Wylie, has been appointed Superintendent of the Tramway Co., in succession to Mr. Boulton, who has accepted an important appointment in connection with the Railway construction works in Formosa.

**PUBLIC WORKS IN SINGAPORE.**—The two principal works at present in progress, and carried out by Government funds in Singapore, are the new wall and embankment at Teluk Ayer, and the retaining wall and reclamation of the land necessary to widen the Esplanade.

**EARTHQUAKE AT RANGOON.**—The severe shock of earthquake that took place at Rangoon a little after 1 A.M. on the 10th instant has caused damage to several Government buildings. It shook the gold vane off the umbrella (*tee*) that surmounts the Shwe Dagon Pagoda.

**ITEMS FROM CHINA.**—Disastrous floods are reported from many parts of China. The Railway extension from Tientsin to Tunghow, which was sanctioned in principle has been shelved for the present. The Tientsin-Kaiping Railway is already at work, two trains running daily between the two terminal points.

**THE INDIAN MINES.**—There has of late been a general improvement in the mining share market, largely increased business being naturally accompanied by a steady advance in prices. In no department, however, has the activity been more continuous, or the rise in prices more persistent than in Indian gold shares.

**AN APPOINTMENT.**—It has been definitely settled that Mr. F. B. Hebbert, Under-Secretary to the Government of Bengal, P. W. D. (Railway Branch), now on deputation

to Simla, will become permanent Assistant Secretary to the Government of India, *vice* Captain G. F. Wilson, R.E., proceeding to England on special duty.

**SIR CHARLES ELLIOT'S TOUR.**—The programme of the official tour of the Public Works Minister during October and November includes Delhi, Lahore, Peshawur, Rawalpindi, Sukkur, Quetta, Karachi, Umballa, and Lucknow. He will leave Simla on 26th October and arrive in Calcutta on 26th November.—*Cui bono?*

**BURMA P. W. D.**—Colonel Cumming, R.E., Chief Engineer, has lately accomplished his second tour of inspection of works in Upper Burma. He has already grasped the requirements of the *new* country, and with the help of Mr. H. J. Richards, C.E., will soon be able to render a good account of his novel and difficult charge.

**THE MADRAS DIAMOND FIELDS COMPANY.**—Mr. Robert G. Orr, the Resident Director, has visited the working at Wajra Karur and was pleased with the progress made in all respects. The boring gangs appeared to take an intelligent interest in their work, and were evidently under systematised control, and looked cheerful, willing workers.

**RAILWAY EXTENSION IN MALAYSIA.**—The Chief Engineer and staff of the concessionaires of the proposed Johore Railway are in Singapore ready to commence a survey, but there are difficulties in the way. These are that the actual construction of the Johore Railway must be commenced within a year from now, failing which the concession lapses.

**THE RAILWAY BILL.**—Lieutenant-Colonel Conway Gordon, Director of State Railways, will not now go on his proposed trip to America, the Secretary of State having telegraphed out his approval of the Railway Bill, and advised a coming despatch. The legislation in this country which should follow its receipt could not be proceeded with in Colonel Conway-Gordon's absence.

**THE PAST AND PRESENT: A COMPARISON.**—A correspondent writes:—The late Sir Proby Cautley had nothing whatever to guide him but his own genius, yet his Solani Aqueduct has never exhibited a single sign of failure, yet the recent similar work on the Lower Ganges Canal, the Nadrai Aqueduct, ignominiously failed a few years, some four or five, after completion.

**PUBLIC WORKS ACCOUNTS.**—A Committee will shortly assemble to examine generally into the working of the whole system of Public Works accounts throughout India. Mr. R. G. Macdonald will be President, and Colonel Harvey, Punjab, and Mr. R. A. Cordner, Executive Engineer, N.-W. P., members. The Committee will be peripatetic, and each Local Government will depute an officer to assist in the inquiry as province after province is visited.

**THE BURMA FORESTS.**—The forests in the seven divisions of Upper Burma will add nearly 14,000 square miles to the forest area of the province, raising the whole to more than 18,000 square miles, an area of a like kind possessed by no other province except the Central Provinces, which has something like 20,000 square miles of forests. But while each square mile of forest land in the Central Provinces yields very nearly £3 per year, a similar area in Lower Burma yields £23-3.

**THE CIVIL ENGINEER AND HIS WORKS.**—Speaking of Sir Frederick Bramwell's address a lay paper observes:—"We shall think better and more kindly, as well as more justly, than some of us are apt to think of the Civil En-



gineer and his works, if we reflect that 'through the ages one increasing purpose runs,' that all sincere effort tends to advance that purpose, and that the agency of the Civil Engineer is as indispensable as that of the philosopher, the poet, the artist, or the statesman, in the great and noble work of making humanity better, happier, and wiser, as the ages roll on."

**THE BEZWADA EXTENSION.**—The remainder of the line to Bezwada, a distance of 45 miles, will, it is said, be completed by January next, the delay being in the erection of the Wyrā bridge, the most tedious piece of workmanship on the section. One of the chief features about the Nizam's Guaranteed State Railway extension is the low cost at which it has been constructed especially when the difficulties that have had to be overcome are taken into consideration. The ruling grade is 1 in 100, and, as a rule, this fits the indulated surface of the country perfectly.

**A SPECIAL ITEM FROM THE N.-W. FRONTIER.**—We hear from the Worth-West Frontier that the Delegates from the Railway Conference spent three days in trials of the Westinghouse and Automatic Vacuum Brakes on the heavy grades near Quetta. It is scarcely probable that such an important question as the selection of a brake for India, will be decided by a mere inspection, especially, as the merits of the two brakes are so evenly balanced, that it would take at least a six months' trial in different places to establish any real superiority of either for the circumstances of this country. *En route*, the Delegates visited the Sukkur Bridge and the Khojak Tunnel.

**MORE TELEGRAPH GRIEVANCES.**—The Sub-Assistant Superintendents of the Telegraph Department are about to memorialise the Director-General against the exclusive recruitment of Assistant Superintendents from England, a practice which shuts the Sub-Assistants out from all hope of rising to a higher rate of pay than Rs. 350 a month. The Telegraph subordinates hold relative rank to the upper subordinates of the Public Works Department, but they are very differently remunerated. Sub-Engineers of the Public Works Department rise to Rs. 500, and are allowed to officiate for Assistant and even Executive Engineers, receiving acting allowances of Rs. 50 and Rs. 100 respectively.

**THE TRANS-FRONTIER PROBLEM.**—According to the Lahore paper work on the Railway in the Khojak Pass is still being pushed on, and large quantities of Railway material are stored there. The Khojak Tunnel will, however, not be through much before the 1st January 1890, if then. The terminus on the Candahar side is Chaman, and beyond this point on the foot of the Khojak no surveys have been made. Our contemporary says:—Supposing, however, the Amir were to ask us to construct the line to Candahar we could hardly, perhaps, refuse our ally's request, as we have material ready; even though our Government has said, on sundry and diverse occasions that it had no intention of making the line.

**ENCOURAGEMENT OF LOCAL MANUFACTURES.**—The *Indian Mirror* observes: It is announced, for the ninety-ninth time, we believe, that Heads of Departments have been requested to use every effort to obtain stores locally instead of from England, provided that no extra cost is entailed. We do not know if the wishes of the Government will be respected by the Departments this time any better than on previous occasions. But if a fresh representation has to be made to Heads of Departments

on the utilization and purchase of articles of indigenous manufacture, may we suggest that these Heads of Departments may be *ordered* to carry out the wishes of Government, and not *requested* as heretofore?

**THE O. AND R. RAILWAY.**—When Government takes over the Oudh and Rohilkhund Railway on the 1st January, the office of the Consulting Engineer will cease to exist, and Colonel Dowden, R.E., will enter upon some new appointment, the head-quarters of which will not, however, be at Lucknow. His two deputies, of course, will also go where duty calls them. One of them, Mr. Penny, has already had his call, and it is rather a far cry. He has to go to Madras, and will be leaving almost immediately. Mr. Burn, the Auditor of Accounts of the Oudh and Rohilkhund Railway, is also under orders, and he will leave Lucknow on being relieved by Mr. Lightfoot from Lahore. Major Sergeant, as already announced, takes up the managery of the line when it passes to the State.

**THE SURVIVAL OF THE FITTEST!**—A Resolution has been issued by the Government of India insisting on the necessity of a strict system of selection for the superior posts of the Public Works Department. The principle has been adopted, (1) that separate rosters of men selected or rejected for the Superintending Engineer class shall be prepared and maintained by local Governments and Administrations; and (2) that a further selection shall be made by the Government of India from these rosters. This will come into force from 1st January, the principle of selection being carried out with utmost strictness in regard to promoting officers to the rank of Superintending and Chief Engineers and posts of corresponding rank. We reproduce the resolution elsewhere.

**PROPOSED NEW HOTEL AT SINGAPORE.**—The idea of improving and increasing the Hotel accommodation in Singapore has assumed a practical shape. The plan of the new Hotel consists of three separate or distinct blocks arranged in a quadrangular form, the out-houses and smaller tenements forming the fourth side. The principal block is the centre one facing the Esplanade and sea, the whole façade of which presents an exceedingly handsome and imposing elevation. The two other blocks or side wings, as they might be termed, face Coleman Street and High Street respectively, and, with one or two slight exceptions, are similar in design to the main block. The design, which is of the modern Italian style, is due to the ability and architectural skill of the Honorable Major McCallum, R.E., C.M.G., the Colonial Engineer.

**TRADE PROCLIVITIES.**—Imitation is the most sincere form of flattery, and we congratulate ourselves that we find an imitator following our lead in every minutiae of detail in the general "get up" of our Journal. It has dropped its figure head after the observation of a contemporary that we were wise in not adopting one. We next find a fortnightly altered into a weekly with the contents metamorphosed both as regards the number of columns and typography generally, the latest alterations being in the matter of notes and official notifications presented in a form closely resembling the arrangement adopted by this Journal and which forms one of its special features. But coming as these do after the announcement of impecuniosity which had to be relieved by a Government grant-in-aid, we hardly think that these attempts at improvement, or any tricks of trade such as was recently practised on advertisers in England by a circular



announcing that it contains more matter—*query*: what sort?—than this Journal, will impose upon the Profession.

**THE E. I. R. COLLIERIES.**—A correspondent writes:—“The letter published by you in last issue relative to the Assistant Manager of the E. I. R. Collieries undertaking private work entailing long absences from his legitimate work gives one an inkling as to why such an expensive establishment is maintained at Giridih, and why the staff has been virtually *duplicated* in late years. It is an open secret that the *Manager* of the E. I. R. Collieries undertakes like jobs on his own account, which explains the *raison d'être* for an “Assistant.” But this is not all. The outside work done by the Manager and Assistant Manager of the E. I. R. Collieries is such that a dozen other equally competent men in private employ, or unemployed, could more conveniently carry out, and as some of these are always available, the action of the Agent in allowing the perpetration of an injustice, which is a crying scandal, is reprehensible.” We are disposed to agree with these strictures, and would invite the attention of the Board of Directors to the matter in the interests of the Company.

**A TEMPEST IN A TEA-POT!**—The ire of the Bombay Government has been roused by no less a person than Mr. Hewlett, who was for many years Sanitary Commissioner of that Presidency. Before retiring he left Government a legacy in the shape of a final report, and that report perpetrates such a libel on the P. W. D. as to elicit a display of anger on the part of Government. The *Times of India* says:—“To libel the Public Works Department is, no doubt, a very grave offence, but it is one not easy to commit. Mr. Hewlett, in the paragraph which has roused the anger of Government, states that sanitary engineering is a special science, and perfectly distinct from ordinary engineering. It is not to be acquired from books, but requires to be learnt in all its details, and must be seen and studied on actual works.\*\*\*Now no one can deny that sanitary engineering is a special science, and that officers of the Public Works Department have no opportunities of learning it. No one can deny that hideous sanitary mistakes have been made in our barracks and other public buildings.”

**MR. HENRY IRWIN.**—The Simla Imperial Circle is to be abolished at the end of the present month. Its Superintending Officer, Mr. Henry Irwin, C.I.E., is transferred to Allahabad, where he undertakes the Superintending Engineership of the 3rd Circle, N.-W. P. and Oudh. It is now seven-and-a-half years since Mr. Irwin came to Simla, to build the public offices. Since then he has designed and superintended the building of the Army Headquarters, and an adjacent block occupied by various offices; the P. W. D. Secretariat; the Post and Telegraph Offices; the Foreign Office, and the Ripon Hospital. He supplied the Simla Municipality with the designs of the Town Hall, and the R. C. community with the drawings of their new Church, now in course of erection. His crowning work in Simla is the Viceregal Lodge, a handsome stone building of the Elizabethan style, which he saw completed during the summer of the present year. He leaves Simla, the city he has beautified, on the 1st of November, carrying with him the best wishes of a large circle of friends and acquaintances.

**COLONEL JACOB'S PORTFOLIO OF WORKING DRAWINGS OF INDIAN ARCHITECTURE.**—The Jeypore Durbar proposes to issue a collection of working drawings in, say, 11 parts, *viz.*:—Part I.—Copings; II.—Pillars, Caps and bases;

III.—Carved Doors; IV.—Brackets; V.—String Courses; VI.—Arches and Lintels; VII.—Parapets and Projecting Eaves; VIII.—Balustrades and Tracery; IX.—Wall Decoration; X.—Wall Recesses and Panels; XI.—Cornices and Ceiling Decorations; each part to be in a separate inexpensive portfolio, the sheets loose, so that any plate could be taken out to work from. The drawings referred to are copies of architectural designs selected from the most celebrated buildings in the North-Western Provinces, Rajputana and the Punjab and they are of a character and size admirably adapted for schools of art, architects and engineer officers, museums, technical schools, artizans, &c. The price of a complete set at 20 plates a part will be—11 parts at 2s. 6d. a part—£1-7-6 exclusive of carriage; but as there will be more than 20 plates in some numbers, the price may be a little higher.

**INDO-BURMA AND CHINA RAILWAY CONNECTIONS.**—The construction of a line of Railway as far as Bhamo offers, we believe, no special engineering difficulties, and although we are well aware that beyond that to the eastward the country is mountainous in a high degree, we are not aware that competent engineering authority has pronounced these difficulties to be insuperable. When, moreover, we reflect upon what engineering skill has accomplished in Europe, especially in Switzerland, the Austrian Tyrol, and Styria, we do not believe that they are beyond the competence of men who have spanned the Hooghly, the Jumna, the Chenab, and other mighty rivers, and are now actively engaged in driving a tunnel through the Amran Range. The question to our untutored minds will probably turn out to be one rather of ways and means than of engineering difficulties, though we would by no means be understood to desire to minimise the latter; and, in the former respect, we are well aware that the Government of India is by no means well equipped to undertake such fresh liabilities as a guarantee upon a heavy outlay of Railway capital would entail.

**THE VACUUM BRAKE.**—Experiments with the Vacuum Brake on the Eastern Bengal Railway have been crowned with the most complete success. A brand new train was fitted up with the brake throughout, under the care of Mr. Jamieson, the newly appointed Locomotive Superintendent of the Bengal State Railways. The work was done at Kanchrapara, and there the feats in question—for they were nothing short of feats—were performed. The train was run out to a level-crossing, and was brought to a standstill on the application of the brake in exactly five seconds. Then it was run back into the station at full speed, when it was suddenly stopped as if by magic. At the time the train had got up a speed of thirty miles an hour, and the brake did its duty within the ten seconds. A third experiment was even more interesting. The accidental disconnecting of trains is a frequent cause of disaster. Such an occurrence, however, is impossible with a train fitted with the Vacuum Brake for the mechanism is automatically applied by the mere act of severance. An experiment of the kind at Kanchrapara shewed that in this respect the brake was a complete safeguard.

**SIND-PISHIN AND BOLAN RAILWAYS.**—The *Civil and Military Gazette* offers the following explanation relative to the Coaching Tariff on our Frontier Railways:—Hitherto the rates in force on the Sind-Pishin and Bolan Railways, for both passengers and goods, have been double the ordinary rates of Railways in the



plains. The necessity for charging increased rates is obvious. The cost of the lines was more than double that of recently constructed Railways in India, and the expenses of working them are very heavy, owing to the steepness of the gradients and the abnormally high rates of labor. The experience of the past 12 months has not, we believe, been such as to justify the expectation that the receipts will, for some time to come, at any rate, exceed or even come up to the actual expenses; but an adjustment of rates for goods traffic is about to be introduced, which should augment the revenue without telling unduly on the trading public. Food grains, which are carried on all lines at specially low rates, will be charged as hitherto at double Indian Railway rates; but other goods traffic will be carried at ordinary rates, *plus* a ghât terminal of two annas per maund per 50 miles, passenger rates will remain the same as at present.

**A SUGGESTION.**—The following is a proposal by Mr. Hewlett, late Sanitary Commissioner, Bombay, who is a veritable enthusiast in the cause of Sanitation:—“In my opinion Government would do well to obtain from England a trained sanitary engineer who has had practical experience in works of water-supply, sewerage, and drainage and in the sanitary construction of buildings. There is ample work for such an officer, and if he came we should not then find tanks made at great expense which will not hold water or soil-pipes built inside the walls of buildings, or the other dangerous mistakes which are now met with in our public buildings. But if this appointment cannot be made, I submit the time has arrived when the officers of Public Works Department should be instructed in sanitary engineering before they come to this country, and should not only have been taught the theory, but have been shewn on works all the practical details of sewers, and have studied the true principles of ventilation, house connections, traps, &c.” The worthy sanitarian is rather “mixed” in his ideas. He forgets that even medical men have to obtain a special qualification in “State Science” before they are qualified to pronounce on questions of public health. We believe that every Physician is not a Surgeon, and *vice versa*. In Medicine and Surgery there are *specialities*, and Engineering has its branches likewise.

**OUR REPLY TO MR. W. H. JOHNSON'S LETTER.**—The words quoted in the second paragraph of Mr. Johnson's letter in our issue of the 6th instant refer to *the men appointed in India*—not necessarily through the Indian Colleges. These men, or most of them, were admitted to the better pension rules under the Resolution of the Government of India, Finance Department, No. 449, dated 18th April 1884. The sentence is somewhat involved, but that is the meaning. Mr. Johnson is correct in saying that the men appointed from Indian Colleges have none of them the better pension rules, though their pension rules were improved when they were admitted to the *new* Uncovenanted Service pension rules. As to the order of 1st April 1876. There was such an order we are sure, but in what form it was issued we cannot say. We have been endeavouring to procure a copy which, when obtained, shall be published as desired. To the best of our recollection it laid down certain distinctions in the leave rules of men appointed from the Indian Colleges, and legislated with retrospective effect with regard to the men who had joined the service from that source between 1872 and 1876, and was the first

public announcement drawing any distinction between the Engineers appointed from Indian Colleges and others. The *Gazettes* of 1876 would probably contain the Resolution, but we have none of that year by us for reference.

**THE BOMBAY P. W. D.**—A Resolution of the Government of Bombay notifies that the appointment of Secretary to Government, in the Public Works Department, which has hitherto been held by the senior Chief Engineer, shall in future be separated, so that the Chief Engineers and professional advisers of Government shall be relieved of purely administrative non-professional duties and kept in direct touch with the engineering operations in the divisions to which they severally belong. In all professional matters the Chief and Superintending Engineers will advise Government on what concerns their respective divisions, and will not be under the criticism or the rule of the departmental Secretary, who will ordinarily be their junior. The Secretary will be selected from the Engineering Establishment list, administrative qualifications being chiefly looked to. A Joint or Under-Secretary will be selected in the same way, and it is intended that either the Secretary or the Joint Secretary shall have experience in questions of irrigation administration. The Resolution is produced *in extenso* elsewhere. The general result of the amalgamation and of the other changes effected will, it is supposed, be an economy of two lakhs a year. The proposal emanated from the Bombay Government some eighteen months since, and has received the approval of the Government of India. Sir Theodore Hope and Sir Charles Elliot were alike consulted in regard to the scheme, but what their opinions were we are not aware. An attempt is made to shirk responsibility for the measure by declaring that in its remote origin the reorganisation now effected dates back to the time of Sir Bartle Frere!!

**“EMINENTLY SATISFACTORY.”**—The statement of Financial Statistics of State Railways for the year 1887, published in the *Gazette of India*, of 6th October, is an interesting study to those who watch the development of Railway communications in this country. It appears that the total amount expended by the State on its Railways (exclusive of the guaranteed lines) has been close on 73 millions sterling. This is about equal to the earnings last year of all the Railways in the United Kingdom. The actual position of the Indian Government with regard to State lines now appears to be as follows: The net receipts (*i.e.*, the amount by which the gross receipts exceed the working expenses) from the commencement of operations to end of 1887, amount to nearly 13 millions, while the interest and other charges are nearly 28½ millions. The net charge to the State is, therefore, 15½ millions, all of which, except three millions, has been incurred on the North-Western Railway, including frontier lines. As there were 694 miles of lines under construction at the end of the year, and upwards of 1,000 miles had been brought into operation during the year, it follows that a large amount of capital had been expended on which no return could be hoped for at present, as newly opened lines do not as a rule pay even their working expenses for the first year or two. Taking this into consideration, it may be concluded that the present position of the State Railways is eminently satisfactory, and it is not too much to anticipate that in three or four years' time all interest charges will be cleared off, except those of the N.-W. Railway, which will be dealt with specially later on.



## Current News.

THE Manora breakwater light has been placed in position.

THE Sinthay Bridge T.-M. Extension, Burmah, had been washed away by heavy floods.

MR. EDWARD HENRY WALLICH is appointed to be First Assistant Engineer in the Larut District of Perak.

MR. D. MORRIS, Executive Engineer, North-Western Railway, is to be placed in charge of the Dandote and Khost coal operations.

THE prospects of the Bombay Victoria Technical Institute are brightening. Already some two hundred and forty boys are at work.

ON return from privilege leave, Captain J. A. Tanner, D. S. O., Royal Engineers, is posted to the Umballa Division Military Works.

THE project of constructing a steam tramway to facilitate Forest operations in Coorg is once more engaging the attention of the authorities.

MR. H. CALDICOTT, District Engineer of Galle, proceeds to the Straits early next month, having been appointed Superintendent of Works at Sungei Ujong.

MR. WALTON will become Superintendent of Way and Works of the Oudh and Rohilkhand Railway when the line is taken over by Government on 1st January.

MR. CROUDACE, Superintendent of Way and Works, North-Western Railway, Sind Section, has been appointed to Mr. H. Bell's Survey of the Delhi-Kotri line.

THE Ahmedabad Municipality has applied to Government for a loan of Rs. 1,50,000 under the provisions of the Local Authorities Loan Act, 1879, for drainage purposes.

THERE is a movement on foot for the purpose of enabling Calcutta to follow the example of the other Presidency towns, and have a Fine Art Exhibition of her own.

COLONEL CONWAY GORDON, Director-General of Railways, has given up his leave Home, as his presence is required in this country to settle some questions in connection with Railway Administration.

AS a consequence of the short fall of rain in the Nizam's Dominions, famine has made its appearance in some of the districts, and it is apprehended it will soon reach Hyderabad itself, where prices have already gone up considerably.

THERE is every probability that the construction of the Dooar Tramway will be shortly put in hand. The papers regarding it are now before the Bengal Government for final orders, and it is probable that work may be commenced this cold season.

MR. J. W. WRIGHT, Superintending Engineer, 2nd Circle, Punjab, proceeds shortly on leave, Mr. E. E. Oliver officiating. Mr. Hilton, Provincial Executive Engineer, Lahore, will probably take up the Under-Secretaryship, P. W. D., during Mr. Oliver's absence.

SIR HENRY MORLAND has served a notice claiming a lakh of rupees compensation from the G. I. P. Railway for injuries received in the carriage accident outside the terminus, and ten thousand rupees in compensation for the injuries received by Lady Morland on the same occasion.

A SKATING Rink on a scale far exceeding anything known in India is now in course of construction on the *maidan* opposite the Indian Museum at Calcutta. The cost of the work has been roughly estimated at £3,000, and it is being carried out at present by Messrs. Ahmuty and Company.

THE Board of Directors of the Indian Midland Railway Company have elected Mr. T. R. Watt (the Managing Director) Chairman of the Company, in succession to Colonel James Holland, who has retired owing to his advanced age, he having been Chairman from the formation of the Company.

COLONEL PEMBERTON leaves Simla on 9th November and reaches Calcutta on the 12th. Colonel Sanford, Inspector-General of Military Works, will accompany General Chesney to Quetta, Karachi and Bombay, and then join the Commander-in-Chief for his tour in the Peshawar District and Rawal Pindi Division.

THE Railway Conference delegates arrived at Lahore on the 10th instant by special train from Quetta. The trials of the rival brakes—the Westinghouse and Vacuum—were carried on in their presence on the steep gradients of the Sind-Pishin line, and they expressed themselves as most pleased with the working of both brakes.

PUBLIC works of utility were carried out last year in the North-West Provinces and Oudh by private individuals at their own expense to the value of Rs. 1,85,250. The largest individual sums spent were about Rs. 30,000 by the Kapurthala Raj, Rs. 15,000 by Abdullah of Mehwa at Allahabad, Rs. 10,000 by Pandit Badri Dat Joshi at Kumaon.

## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

### BEES IN TIMBER.

SIR,—With reference to X's inquiry in your issue of the 6th instant we write to say that we can supply Jeyes' Wood Preserver which will preserve the wood, and keep it from the attacks of bees and white ants.

GEO. GAHAGAN & Co.

BOMBAY; October 10.

### RAILWAY BRAKES.

SIR,—With reference to "M. I. M. E's" letter in your issue of 6th October, I believe the following continuous brakes are in use, but cannot say that the list is complete:—

B. B. and C. I. Co.—Simple Vacuum.

E. B. R. and G. I. P.—Automatic Vacuum.

S. M. Ry.—Westinghouse

And a few sets of both Westinghouse and Automatic Vacuum on the Sind-Pishin Railway.

October 10, 1888.

F. E. R.

### AN ENQUIRY.

SIR,—Can any of your numerous readers inform through your columns if there are any titles or marks of distinctions for the European or Native Christian subordinates of the P. W. D. similar to "Row Bhadur," "Row Saeb," "Khan Bahadur," &c., which are to be given, on recommendation by the Executive Engineers, to the Native subordinates of the Department above the grade of Overseer, according to the Government Resolution circulated few years back? If there is none, it seems a piece of injustice, the cause of which is not understood, and the result will naturally be disheartening to the exempted.

R.

### THE PERIYAR PROJECT.

SIR,—I see in page 247 a notice under the head of "Notes and Comments" of No. 13 of Vol. IV. of the 29th September 1888, wherein the works of the Periyar Project are reviewed. Please note that all the works therein mentioned, *viz.*, the escape and the dam, and all the buildings, including office, &c., are all Mr. R. P. Roy's works for both July and August, with the exception of the escape, which since September last was given to Mr. Sheppard, another contractor, and a very energetic executive agent too. Mr. Roy still has the main dam, the office, and eighteen other buildings; besides tree felling and boat making, also lime, &c., supply business, and he has taken the Muliya-Panjam sand collection works. The difficulties that these contractors have to contend with cannot be over estimated. All the buildings are about finished, and the office and store, along with some other buildings, will be ready and occupied by 1st November next. A tram line is being laid from the foot of the ghât road to Tekadi.

ETE-WITNESS.



## EQUALITY AND FRATERNITY.

SIR,—In reply to the letter of "Viator" under this heading in your issue of 6th October, I can assure him, and others similarly situated, that it is a subject of regret to the C. E. Defence Committee that so many men remain under a false impression respecting the actions and ideas of the Committee regarding the men from Indian Colleges. It would intrude too much on your space to give full particulars of all that has been done in this connection, but the following short extracts from documents published by the C. E. Defence Committee will shew that the subject is not neglected, and that the fault of the misapprehension rests rather with the men themselves, who will not take the trouble to read up the subject, than with the Committee, who do all they can to keep everybody informed.

No. 18 P. W., dated 22nd March 1883, from the Secretary of State, to the Government of India, para. 15:—"The new scale of pensions with these additions will in future be applicable to all the European Civil Engineers of the Superior Engineering Branch of the P. W. D."—Extract from a letter by Mr. Carbutt, M.P., to the Secretary of State, dated 13th June 1885:—"Pensions \* \* \* For I notice an attempt is made to minimise the concession made by you, and to confine its application to certain classes of European Civil Engineers only. This is most unfortunate, for it is an attempt to draw a line between, and to cause jealousy among, the large body of Civil Engineers in the Department where none at present exists."

Extract from a letter, dated 21st January 1886, from Mr. Carbutt, M.P., to the Secretary of State:—"May I then ask if your Lordship will favor me by looking personally into the question; when I feel sure you will decide in accordance with the decision of your predecessors, that in future there shall exist in India perfect equality of treatment among all members of the Department, both Civil and Military."

I trust the above extracts will convince the doubtful, that the C. E. Committee insist quite as much on equality among themselves as with the R. E's, and that they have actually obtained the concession from the Secretary of State, but that it is still withheld by the Government of India alone.

So long as all do not join, the Government of India may affect to consider the agitation as due only to a few grumblers, but they cannot afford to disregard the unanimous cry of a whole Department; "Fulfil your repeated promises."

STANLEY ENGINEER.

## P. W. D. RE-ORGANIZATION.

SIR,—Under the scheme for separate Imperial and Provincial Establishments of Public Works prepared with reference to proposals by the Public Service Commission, the proposals are to form two separate Establishments—the Imperial, recruited from Cooper's Hill and the Royal Engineers; and the Provincial, recruited in India.

The Government of India ask:—

1st.—What, looking into the far future, is to be the respective strength of each Establishment?

2nd.—What are the rates of pay and promotion for the Provincial Establishment to be?

3rd.—Are the superior appointments to be made on one scale of pay and open by selection to Imperial and Provincial men alike?

4th.—In distributing the present Establishment how is the line to be drawn between Imperial and Provincial, &c.?

5th.—Looking at the smallness of numbers in each Service, is it possible to work them separately and independently?

It appears to be wrong to have two regular services, one inferior to the other.

There should be one regular Service of the strength required recruited from Royal Engineers and Cooper's Hill, and as regards any other Engineers required, they should be obtained from the open market, being paid according to their qualifications and the importance of the posts they might be required to fill. Engagements might be made for 3 or 5 years, to be renewed or not as the parties to the contract might be willing. No pensions should be given, but the pay should be so adjusted that 10 per cent. might be deducted monthly to be given to the officer at the expiration of his agreement if his services were dispensed with. This deferred pay would also be a guarantee fund to indemnify Government from loss owing to fraud on the part of the officer concerned.

Then as regards the 1st question of the Government of India, it would only be necessary to settle the strength of the Imperial Service, leaving each Local Administration to fill up its other vacancies by temporary engagements, with perhaps a slight extension of its superior subordinate service.

As regards the 2nd question concerning pay and promotion, it might be advisable to make some alterations in the present pay of the Department in the Superintending Engineer grades. For instance, the difference of responsibility between Superintending and Executive Engineers should be more emphasised, as also the step from Superintending Engineer to Chief Engineer.

This should be—

				Rs.
Superintending Engineer	...	...	3rd class	1,250
			2nd "	1,450
			1st "	1,650
Chief Engineer	...	...	3rd "	2,000
			2nd "	2,250
			1st "	2,500

As regards the pay of men temporarily engaged, it would depend entirely on the importance of the work for which they are engaged, and the rate at which they could be obtained, so each Local Administration would settle this question for themselves, getting the best men they could.

On the 4th question relating to the re-organization of the present Department on the proposed lines, discussion is deferred.

The 5th question, if this proposal were adopted, need not be answered.

It would be a very great mistake to create a Provincial Branch slightly inferior to the Imperial, as they would be certain to be dissatisfied, and in time as their numbers increased would claim the same privileges as the superior branch, and, if doing the same work, rightly so.

In obtaining men from the open market on terminable agreements, they would naturally do their best, as their prospects would depend on their work. The best men would come to the front and have their agreements renewed at a high rate.

Any men of exceptional merit that a Local Administration might wish to retain as a Superintending Engineers might, on the sanction of the Imperial Government, be appointed on the same standing as the Imperial list, only without any pension except the special pension after 3 years in the grade of Superintending or Chief Engineer.

If this principle of having one regular Service sufficient for ordinary requirements and meeting extraordinary calls by engaging men for certain works and short terms had been in force years ago, the Government would not have been in the present difficulty.

The great problem now is how to reduce the overgrown Department without injustice to the present incumbents.

October 13, 1888.

G. E. M.

## BANGALORE WATER-SUPPLY.

SIR,—Some time ago you published from a correspondent some criticisms on my project for the water-supply of this station, in which it was attempted to shew I was hopelessly wrong as to the catchment area of the Hebbal tank basin, and the probable run-off in Mysore. I had surveyed and prepared a plan of the former, but as regards the latter very considerable doubts existed. The late Captain Romilly, R.E., had declared there were no data in existence from which even an approximate idea of this could be formed, so I used Molesworth's data, modifying these to suit the character of a season's rainfall, and found that by so doing I agreed very well with the results recorded by Mr. Binnie at Nagpore: at the same time my own opinion was that in such a basin as Hebbal, consisting largely of steep "moorland," a very much larger quantity of water does run off in seasons of heavy or flood rainfall, quite as much as English Engineers have recorded, viz., from '6 to '8 of the total fall for such years.

I now send you a few details of what has actually occurred here. The season has been a very unfavorable one for tank filling, and on the 13th September last Hebbal tank was  $4\frac{1}{2}$  below full tank level, when the rains commenced, and by the 25th the tank was quite full, and began to surplus, and this it has continued to do up to this date, not heavily, only about 6 inches at the most passing over a weir 60 feet in length. The rains have been very moderate and partial, only 4.81 having been registered between the 13th and 30th of September last, yet the surplus has flowed continuously from the 26th idem.

The Hebbal basin I have said contains about 14 square miles, and I allowed 4 square miles as sufficient in seasons of heavy rainfall to fill the small cattle *coontahs* above the principal tank, which I proposed to enlarge and improve for the use of this large station and all its population. From what has already taken place in this catchment area, in such an unfavorable season as this, it is quite apparent I had formed a correct idea of its capabilities to yield a sufficient supply of water, if properly stored, for all purposes, and during the hugest droughts, and I was led to state this from my long experience of some taluqs adjoining the Mysore territory in which there are numerous tanks, having much the same kind of catchment basins, and which had been all improved successfully on the data used at Home.

I trust, therefore, you will be good enough to publish this letter in an early issue of your valuable journal, as it contains simple facts, which any one can test, and vindicates the opinion I have all along maintained that this station can be well and economically supplied with water from Hebbal by a very simple project.

THO. F. FISCHER, General, R.E.

BANGALORE; October 3.



## IRRIGATION IN THE PUNJAB.

## I.

SIR,—The Irrigation Revenue Report of the Punjab for 1886-87 is a very interesting document, as it proves conclusively that canals constructed in that Province with the latest and most modern improvements will repay the cost of construction, including interest on capital, in a period of, at the very utmost, thirty-five to forty years. Thus the Bari Doab Canal, which had cost up to the close of the year under review no less a sum than Rs. 1,61,36,024, had an outstanding debit against it at the above period (the end of 1886-87) of Rs. 40,56,851, which, at the present rate of progress, the Chief Engineer confidently asserts will be cleared off in six years, that is, by the close of 1893; and as this Canal was opened for irrigation in 1859, this would make the period in which a perfectly new and well constructed canal will repay the capital and interest expended on it in thirty-five years, or, to be perfectly safe, in forty years.

To take the canals as they stand in the Report, however, the first is the *Western Jumna Canal*, the capital expenditure on which at the close of 1886-87 amounted to Rs. 1,05,84,893, and the profits to Rs. 3,72,948, being 3.52 per cent. on the capital; but as the interest on capital amounted to Rs. 3,97,392 there was an apparent loss of Rs. 24,444, but this loss is more apparent than real, for, notwithstanding this apparent loss, this Canal has still a credit balance to its name amounting to Rs. 2,78,66,104, that is, the old Western Jumna Canal had repaid the British Government about Rs. 3,84,50,997 over and above the expenditure incurred by the late Sir. William Baker, R.E., in his remodelling the old native canal in about the years 1823-30, in which latter year the Eastern Jumna Canal was re-opened by that Prince of Canal Engineers, the late Sir Proby Cautley, at which period Sir W. Baker was "Superintendent of Canals West of the Jumna."

The present Western Jumna Canal has been almost entirely reconstructed; this reconstruction having been, it is believed, initiated and partially carried out under Colonel A. M. Brandreth, R.E., the present talented Principal of the Thomason College, Roorkee. This Canal repaid 25 per cent. on capital prior to reconstruction, as the Eastern Jumna Canal probably does at present. With these results before him, the Chief Engineer may well add that the "Punjab presents an unrivalled field for irrigation projects." The reconstruction of this Canal was manifestly very carefully designed. This is established by the very insignificant ratio of Lift to Flow irrigation, which in 1882-83 was Flow 93.2, Lift 6.8, and in 1886-87 Flow was precisely similar, while in 1884-85 Flow was 94.8, Lift 5.2, and in the following year, 1885-86 Flow was 94.4, Lift 5.6. This is the very highest test of the abilities of a canal officer in diminishing Lift irrigation, which pays only half rate to Government. These ratios of Flow and Lift irrigation are, it is confidently believed, the most favorable in India. The estimated value of the crops irrigated during 1886-87 by the Western Jumna Canal amounted to Rs. 1,16,78,994, the previous year's estimate having been Rs. 80,80,115, being an increase of Rs. 35,98,879. The length of canals open during the year was 370 miles, and when the new Sirsa Branch has been completed, the foregoing figures will be greatly increased.

<i>Bari Doab Canals.</i> —The capital expenditure on this system of canals amounted at the close	Rs.
of 1886-87 to	1,61,36,024
While the working expenses amounted to	5,91,230
Interest on capital	6,19,036

	12,10,266
Income during the year	18,96,345

being a return of 4.25 per cent. on capital expenditure, and as there was at the close of the year an outstanding debit against this Canal of Rs. 40,56,851, the whole of this will probably be cleared off by the close of 1893, as confidently predicted by the Chief Engineer.

The proportion of Lift to Flow irrigation is much higher on this Canal than on the Western Jumna, having been in 1882-83 Flow 89.10, Lift 10.90, and in 1886-87 Flow 88.85, Lift 11.15. Every effort should be made to diminish Lift irrigation, which, as previously stated, is a serious loss to Government.

The estimated value of produce irrigated by the Bari Doab system of canals in the year amounted to Rs. 1,22,93,174, being an apparent decrease of Rs. 30,22,544, but, as previously explained, this apparent decrease is owing to a favorable rainfall and is, therefore, no real criterion of the benefits conferred by Canal irrigation.

As the original estimate of the Bari Doab canal is before me, it is exceedingly interesting to compare the results actually attained after 28 years' working; these are as follows:—

Capital expenditure up to close of 1886-87	1,61,36,024	Rs.
Estimated expenditure	52,76,972	"
Being an excess of	1,08,59,052	"
Estimated water-rate	15,80,500	"
Actual realizations, 1886-87	11,76,007	"
Less than original estimate	4,04,493	"

Actual realized, 1886-87	...	...	1,15,370	Rs.
Estimated, miscellaneous	...	...	81,000	"
More than estimate	...	...	34,370	"
Actual working expenses and interest charges	...	...	12,10,266	"
Original estimate	...	...	2,00,000	"
More than estimate	...	...	10,10,266	"
Estimated return on capital	...	...	27.5	per cent.
Actual realized, 1886-87	...	...	4.25	"
Estimated area for irrigation	...	...	6,54,000	acres.
Actually irrigated, 1886-87	...	...	4,05,152	"
Less than estimate	...	...	2,48,848	"
Estimated duty per cubic foot	...	...	218	"
Actual realized, 1885-86, highest	...	...	199	"
Less than estimate	...	...	19	"
Estimated lengths of canal, main line, towards	...	...		
Mooltan	...	...	247	miles.
Kussoor Branch	...	...	84	"
Lahore	...	...	74	"
Sobraon	...	...	61	"
Being a total length of canals	...	...	466	"
Actually constructed	...	...	354	"
Remaining to complete	...	...	112	"

From the foregoing it will be seen that the original estimated capital expenditure was more than trebled, whereas the receipts from miscellaneous sources have been considerably greater than originally estimated. The working expenses in original estimate apparently did not provide for interest charges, as in those days the allotments for all public works, canals included, were provided from surplus revenue, hence the omission.

Although the discrepancies between actual results and the original estimate for this Canal may appear great, yet the original estimate was most carefully prepared by the late Colonel Dyas, R.E., and carefully scrutinized by Lord Napier of Magdala, then Chief Engineer, Punjab. Still there was very inadequate data to base an estimate on, especially for a new country as the Punjab then was.

The only irrigation works then in operation were the Eastern and Western Jumna Canals, which have always yielded splendid returns. The Ganges Canal had only just been partially opened and irrigation scarcely commenced. The rates for work, however, were adopted from actuals on the Ganges Canal, *plus* 25 per cent.; that even proved wholly inadequate on the Bari Doab Canal, where laborers had to be taught every thing and coaxed to work for their own benefit.

The capacity of the Bari Doab Canal is 3,000 cubic feet per second; but this, again, has never been attained, the river not affording this supply, except in 1883-84, when the supply entering the canal head was 3,036 cubic feet per second, and in 1885-86, when the supply entering was 3,196 cubic feet per second. Again, the duty per cubic foot of supply estimated to irrigate 218 acres has never been realized, 199 acres per cubic foot being apparently the highest duty attained. The estimate of 218 acres per cubic foot was adopted from Sir Proby Cautley's experience on the Eastern Jumna Canal, and was, therefore, the very highest authority in India. But the old conservative Punjabee cultivator is a very different being from the sturdy go-ahead *jāt* cultivator of the N.-W. P.; the former resisted the introduction and use of canal water for years, whereas the latter gladly availed themselves of the boon from the very commencement; indeed, they formed themselves into joint stock companies, on a small scale, entrusting the funds and working of the concern to Sir Proby Cautley; and by these means he was enabled to construct Rajbhuas, as the Government of those days would only sanction the construction of the main canals.

The original estimate for the Bari Doab Canal provided for the masonry heads of Rajbhuas only. The construction of the Rajbhuas proper with their numerous bridges, culverts, and millpools were subsequently sanctioned, year by year, as funds were available. The Sirhind Canal, it is believed, was the first work of the kind constructed from borrowed capital and contributions from Native States, whose lands are being irrigated by this Canal. But, perhaps, the most important point of all is the fact that the original project has never been completed. As previously stated, this contemplated 247 miles of main canal and was intended to tail into the parent stream (Ravi) within 58 miles of Mooltan, at Furreed Kakoo, between Chechewutni and Tolumba, whereas apparently 112 miles of this still remains to complete the original project.



## General Articles.

### PUBLIC WORKS OFFICES, MADRAS.

THE accompanying illustration is an elevation of the Department Public Works and Chief Engineer's offices, Madras. This building was erected in 1865 as a workshop and foundry for that department, and was used as such for many years. Its location being on the side of the South Beach Road, near to the health-giving, rolling sea-breakers, and one of the brightest spots in the city, it was considered a very suitable building for a military hospital, and the workshop was made to vacate it. After a good deal of discussion, the hospital project was abandoned, and the building made over to the professional department as offices. It may have been thought, that the weary Engineers needed more of the sea air and physical recuperation, than the well fed and well housed military, and in this perhaps the Government were not very far wrong. True to its architectural traditions, the P. W. D. of a quarter century ago, had designed the old building in the manner so happily described in the "Journal of Indian Art." Special pains seem to have been taken to intensify its ugliness. Following perhaps the instructions of Fergusson, that the face of a building should be the index of its uses, which in this case was the rough manipulations of a workshop, dull, sombre repulsiveness may have been considered a legitimate characteristic in an age when whitewash and daub formed the principal architectural beauties of all Government buildings.

When Sir Grant Duff was projecting his now famous "Marina," this building stood like a ghost on the landscape, and took the smile out of all faces that approached it. Cæsar though our late Governor would like to have been, to demolish it was quite out of the question, and we had not the appliances to roll it out of sight as our American friends would have done. In this dilemma, the quick resources of our then Consulting Architect, Mr. Chisholm, were solicited and, as always, he was found equal to the occasion. As additional space was required for draftsmen and a verandah for over active officers, he suggested giving this additional accommodation by screening the old building with a new face. This was approved of, and after a few months of scaffolding-up, the old ugly barbarism re-appeared transformed with a bright new shining civilized face, as shewn in our illustration, and was welcomed with a smile from all.

To those who understand such things, the style of the new face will probably be called "High Renaissance," recalling reminiscences of Florence and Venice, and a not unpleasing variety on the adjacent elegant Indo-Saracenic buildings, shewing the versatility of our late much-esteemed Government Architect. If it is a work of difficulty to design a beautiful and suitable new building, and the difficulty is increased a hundredfold when one is trammelled with the proportions of an existing old construction, as was here the case; yet all Madras admitted, and all our readers will also concur, that the genial Architect has come out of the ordeal with very great credit. Madras sees in this new façade to an old building an illustration of a great deal that Mr. Chisholm has done for the improvements of a large portion of their city. It was a proud boast of the old Emperors to have said, that they found the Eternal City of bricks, and had converted it into one of marble or of gold. But it would have shewn a higher measure of real good accomplishment, if they had been able to say instead, that they had so taught their people to use the same old bricks, as to make the contrast between the old and new city, as between bricks, marble and gold. This is what Mr. Chisholm has taught the bricklayers and artisans of Madras. By new arrangements to bring forth new and marvellous effects from much the same old materials, and "Chisholm muster" has become a household word among them, and is being adopted in most private works. But everyone works under a pall in the Benighted, and it is no wonder our old Architect has fled to pastures new.

### BICYCLE RUNNING.

By A. EWBank.

#### IV.

IN the last paper we may be supposed to have been arguing with an intelligent spectator—who has watched a bicycle run, but has never himself been a rider—that the handle which he sees the bicyclist holding is not exactly helm or rudder. The argument of course was not completed. It was in fact merely opened.

Not only have we conceded the fact that the forward position of the handle and connected wheel supplies no argument against the rudder hypothesis, but we have taken the pains to prove that, as far as mere turning of a ship, a forward rudder could act effectively.

Let a steamer move in still air through a calm ocean which has no currents. Then we can imagine it moving in a chosen direction, say due north, without assistance from the rudder. We can also imagine the ship to be free from rolling. Let the rudder at the stern now be shifted eastwards, and let us consider, not only the several effects, but also their sequence or order of occurrence in time.

The ship will not deflect till the rudder is actually turned. The turning of the rudder is the sole cause of the ship's turning. The rudder turns *first* and the deflection follows as an effect and, therefore, as a subsequent occurrence. The deflection may be considered practically as a rotation about some vertical axis. This assertion implies that we deny to the ship any rolling or heeling over. We might deny the existence of any rolling, as a *cause* of deflection, and we might, as quite a separate matter, deny the existence of any rolling as an *effect* of deflection.

But, strictly speaking, the water is collected by the rudder and heaped up on the starboard side to a greater height than the water reaches on the port side. Hence the ship must heel over a little. But this heeling over, whose existence we thus admit, is an effect of the rudder action. It follows the rudder action in time. This heeling over may be made as slight as we like, if we take a longer time to make the ship's course change by the same amount as before and any heeling over is to the port side while the ship veers to the starboard side.

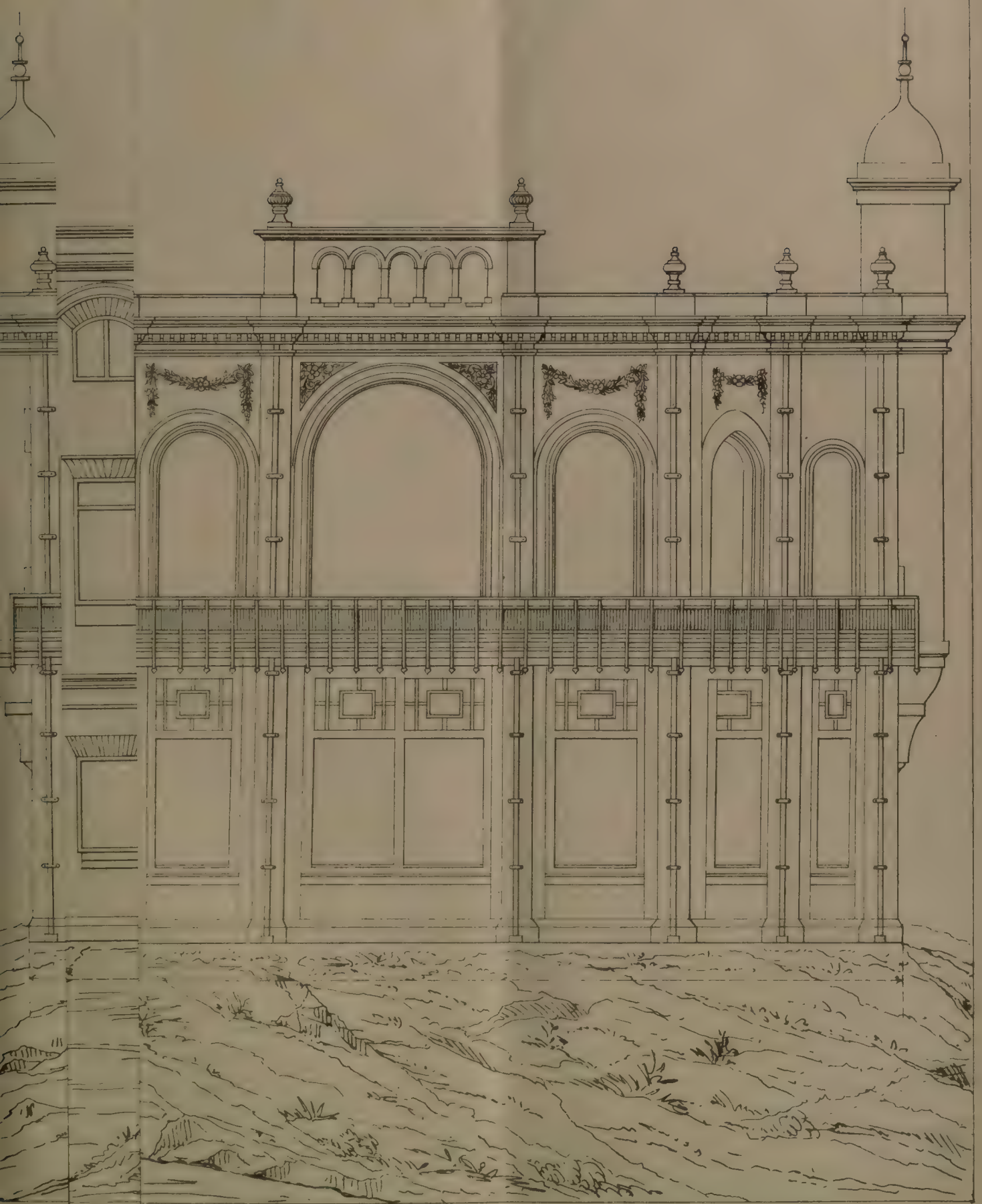
Again, when anybody out of water or in water is moving in a curve, there is a force called centrifugal force at work. In the case of the ship this force acts through the centre of gravity, and it does not cause any tendency to heel over.

We now may consider a tricycle in the act of changing its course. The *first* movement is that of the steering apparatus. The second in point of time is the deflection of the course. This deflection is distinctly the effect of the turn of the steering handle. As the tricycle moves round a curve, centrifugal force *as usual* acts through its centre of gravity. But the machine touches the ground at points of the machine which are all under the centre of gravity. The consequence is that the machine, if travelling fast enough and turned sharp enough, may heel over. This heeling over, if it does occur, is the effect of an effect. First, in order of time, comes the twist given to the steering apparatus. Secondly, comes the change of the straight course to a curved course. Thirdly, a heeling over in consequence of this curvature in the course, combined with the fact that the machine touches a fixed body—*viz.*, the ground—at points of the machine, which are all lower than the centre of gravity. Thus the tricycle has certain points of resemblance to the ship in the sequence of events—but the resemblance is not complete, as the centrifugal force acts differently in the two cases.

A tricycle, like any ordinary carriage, tends on turning a sharp corner to heel over to what we may call the outside of the curve or the outside edge. Similarly, a horse galloping swiftly round in a sharp turn, has a tendency to fall over on the outside. The horse is quite aware of this and we see him lean inwards.

Now suppose that a fly or other insect could gallop round a sharp corner on the ceiling of a room. He





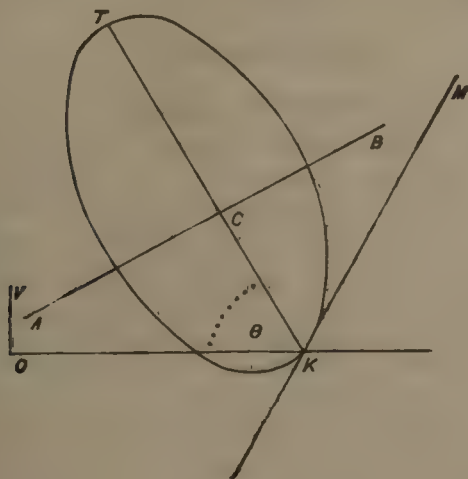






suffers from the ceiling certain forces which are *above* his centre of gravity. These forces resist the centrifugal tendency which act through his centre of gravity. The consequence is, that he is by the forces made to incline in the opposite way to what he would incline if he galloped round a curve on the ground.

*Fig. 2.*



To make this point clear, let us again look at *fig. 2*. A horse or an insect or a man runs round a circle whose centre is O. The animal, whatever it be, is at the moment at K and running due north in the direction K M. To resist the possible consequences of centrifugal force, the animal leans in a direction which we describe as sloping up to the left or to the west. Or, we may say that the components of the slope measured on the upward slope are vertical upwards and horizontal west.

The tendency of the centrifugal force is to make the body slope upwards to the right, or to the east, or to the outside edge.

If now we have an insect galloping round a curve on the ceiling—or a carriage running round the ceiling whose specific gravity is less than that of the air—we may consider T in the figure to be a foot of the insect or a wheel of the carriage. The centrifugal force will tend to make the body take the actual position we have given it in the figure, and the insect will, as a precautionary measure, throw its body into a position different from T K. Its body will be made to slope downwards to the left, whereas on the ground its body was, as a precautionary measure, made to slope upwards to the left. Relatively to the new conditions, this new precautionary attitude is equivalent to the old.

A ship half buried in the water is not acted on by the centrifugal force as is a carriage, or as would be a sledge or an ice-yacht. Nor is it acted on in that contrasting fashion which is illustrated by an insect on a ceiling.

But now consider what happens if a bicycle has an experienced rider. The rider does *not* begin by turning the handle. He begins by leaning over to one side. This makes the bicycle heel over, and then each wheel, by the law of its rolling, tries to move in a curve. Here the heeling over is introduced, not as a possible effect due to centrifugal or others forces, but as a cause, and as *the* cause.

What then is the use of the driving handle? This question we shall answer by degrees.

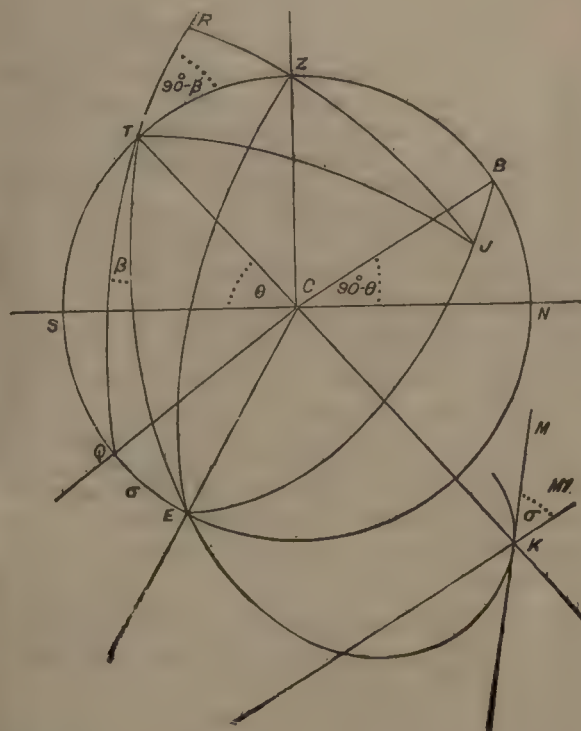
The business of the helmsman is to grasp the tiller and allow it no freedom of its own. The wisdom of the bicyclist will be to hold the handle loosely and to allow it some freedom of its own. This point will be illustrated in the sequel.

The ship in still water, or the tricycle on a level road, is meant to move on an even keel. The bicycle is not

meant to move on an even keel. In other words, it will generally not be upright, and generally it ought not to be upright. In a run of an hour the aggregate sum of the moments during which the bicycle was upright will not amount to five minutes, and should not amount to five minutes if the necessary track is a winding track.

But even were the bicycle more often upright than at some variable slope  $\theta$  to the horizon, we ought still to make our calculations on the general case  $\theta$ . For we can always by putting  $\text{Sin } \theta = 1$  and  $\text{Cos } \theta = 0$  obtain the special results for an upright bicycle. But if we commence by taking  $\theta = 90^\circ$ , then those terms that would contain  $\text{Cos } \theta$  as a factor do not shew themselves, and we have no indications of their existence. We commence, therefore, by putting the bicycle driving wheel on a slope  $\theta$  and we will first ask what mere geometrical effects result from a turn of the handle. By a turn of the handle we necessarily mean a rotation of the driving wheel about a certain line in the wheel plane.

*Fig. 5.*



*Fig. 5* may at first seem rather a complicated figure to represent a single bicycle wheel. The reader is supposed to hold the paper up and to look at it in a direction due west. *C* is the centre of the driving wheel and *TK* is a diameter. *KM* is the momentary track. *KM* is due west. *CE* is a line due east, *i.e.*, proceeding directly towards the observer. *CN* is due north, *CZ* is vertical and *CB* is a line sloping upwards and normal to the wheel plane *TEK*. *CB* thus lies in the meridian *STN*. The slope,  $\theta$  of the wheel is the angle between the wheel plane *CTE* and the horizon *CSE*. We could, of course, have considered, not the inclination of the wheel to the horizon, but the complementary inclination to the vertical.

The ground being level, is parallel to the horizontal plane C S E. Thus the wheel plane is cut by the ground in the track line K M, and by C S E in the parallel line E C.

The wheel plane is to revolve about the line  $K T$  or  $C T$  through a certain arbitrarily chosen angle  $\beta$ , and we wish first to learn some of the geometrical effects on the bicycle of this  $\beta$ -rotation, as we shall call it. The wheel plane therefore passes from the position of the great circle  $T E K$  to the position of another great circle  $T Q$ , which produced would pass through  $K$ .

The meridian plane  $ZT$  cuts the wheel plane  $ET$  at right angles. When the wheel takes the position of the



Plane Q T we have the angle Q T S acute. Accordingly if we produce Q T, we can draw a perpendicular Z R on to the new wheel plane or great circle Q T R. Z R is the new minimum zenith distance of the wheel plane considered as a great circle. R Z produced cuts in J the great circle B E, to which the line C T is a normal. Z J or the angle Z C J is the new slope of the wheel just as Z B was equal to the old slope of the wheel.

Now  $\theta$  and  $\beta$  are, for us, given or arbitrary quantities. We may ask for the new inclinations of the wheel to the horizon. This we are to calculate in terms of  $\theta$  and  $\beta$ . We may also calculate in terms of  $\theta$  and  $\beta$  the direction of the new track K M<sup>1</sup>, or its parallel line Q C.

If a bicycle is upright, and its rider gives the driving handle a  $\beta$ -rotation, he does not change his own height above the ground. He does not raise or sink the centre of the driving wheel. But if the bicycle is not upright, he lifts the driving wheel if he gives it a  $\beta$ -rotation either way. He, therefore, lifts himself. This is a point worth noticing. If we are thinking of the dynamics of the bicycle, we conclude that it must be more difficult to give a  $\beta$ -rotation to a sloping wheel than to an upright wheel. For in the former case additional work must be done in lifting a certain weight. Of course, in both cases work is done in overcoming friction as small elements of the wheel near K are urged laterally or broadside over the rough ground. Experience shews that many bicyclists when told that they lift themselves by giving a  $\beta$ -rotation to a sloping wheel, are inclined to deny the statement. Yet the figure shews that Z R is less than Z T.

In the figure the reader is behind a travelling bicycle. He sees the bicycle sloping over to the left. The driving wheel is seen to take that  $\beta$ -rotation which corresponds to the handle moving clockwise as seen from a point above this handle. In this case, the track which was due west is changed to a track between west and north. We may say that the handle or the front wheel gets a twist to the right, and that the deflection of the track is also to the right. The bicycle being on a left slope, is travelling on a curved track which bears to the left and has K M for a momentary track. Thus our clockwise  $\beta$ -rotation has an influence opposed to that of the heeling over of the bicycle.

If the rider gave his handle a counter-clockwise  $\beta$ -rotation, he would also lift the front wheel and himself. To consider the geometry of this opposite  $\beta$ -rotation we should need a different figure.

In the old position T E of the wheel C T is the line in the wheel of greatest slope. C E is the line of no slope. The arc B J E is a quadrant. In the new position Q T R of the wheel C R is the diameter of greatest slope. R is the new highest point of the wheel. If a chalk mark is made at T on the wheel, this chalk mark is no longer the highest point of the wheel in the new position. The tangent line at T to the wheel circle E T is a horizontal line parallel to E C.

The tangent line at T to the new wheel plane Q T R is a line sloping upwards if we start from the east side of T and pass to the west side. If we produce the great circle J E to meet the great circle T Q, we get a quadrant measured from J through E. This is not shewn in the figure. The arc beyond E is  $\beta$  and B J is also  $\beta$ . T is the pole of the circle B J E, and J is the pole of Q T R.

Let the new wheel plane have a slope  $\omega$  to the horizon.

$$\cos \omega = \cos Z J$$

$$\cos Z B, \cos B J$$

$$\cos \theta \cos \beta$$

(1)

This equation shews that  $\omega > \theta$

Merely as a geometrical illustration of this equation let  $\theta = 45^\circ$  and let the handle twist  $\beta$  be also  $45^\circ$ .

Then  $\omega = 60^\circ$ .

Let the wheel in this particular case have a diameter of 50 inches. Then initially its highest point T was above the ground a distance  $50 \sin 45 = 25 \sqrt{2} = 35.35$  inches. When the wheel plane takes a slope of  $60^\circ$  the height of the new highest point R becomes  $50 \sin 60^\circ = 25 \sqrt{3} = 43.30$ .

There is, therefore, a lift of a little under 8 inches. The wheel centre gets half this lift, the wheel handle gets more than double what the centre gets. The figure does not completely illustrate this lift. It shews that R will be higher than T. If the reader will draw the circles on a wooden globe the case will be made much clearer. The equation  $\cos Z J = \cos Z B \cos B J$  is quoted from Spherical Trigonometry. It is also proved in the first paper of the recently concluded "Notes on Navigation." It results from the angle Z B J being a right angle.

## NOTES FROM HOME.

(From our own Correspondent.)

AN accident, which would have caused greater alarm had it occurred during the time of the Rai way race to Edinburgh, occurred to the Scotch Mail between Wigan and Warrington on the London and North-Western Railway on the 17th instant. The train was running at the rate of 60 miles an hour when the axle of the leading wheels of a fish van broke. The train however was promptly pulled up by the continuous brakes, and although the carriage in question lost the two wheels, the close coupling kept it on the line. This accident is worth alluding to as shewing the value of modern appliances in securing the safety of fast traffic.

The fourth triennial Congress of Geologists commenced its sittings on the 17th instant at the London University, Burlington Gardens. Great regret was expressed at the opening meeting that Professor Huxley, the Honorary President, was unable, through ill health, to welcome the visitors. Professor Prestwich, the President, delivered an address in French, and several interesting papers were afterwards read.

An enquiry is now being held at Manchester by the Local Government Board as to the expediency of sanctioning an expenditure of about half a million sterling for a new sewerage scheme for that city. It is proposed to construct two principal sewers 7 feet and 9 feet in diameter to the City Boundary. From thence it will be taken by an outfall sewer 10 feet 6 inches in diameter along Stretford Road to the works near the Irwell. It is then proposed that the sewage should be dealt with in tanks by the precipitation process, the effluent being again treated by a system of intermittent downward filtration. This effluent, which is calculated to reach the quantity of 10 million gallons per day, will then be poured into the Manchester Ship Canal provided it fulfil the stipulation that it be not injurious. The residue it is proposed to dispose of by the Leeds method. I understand that there is a great opposition to the scheme by Local Boards and property owners in the District.

The Report of the Metropolitan Board of Works for 1887 gives valuable particulars of their method of dealing with the London sewage. On the question of deodorization the Board consulted the eminent chemist, Sir H. Roscoe, as to the advisability of continuing the practice of introducing deodorizing materials into the sewers during the summer months; and the result of his advice has been that the Board has reverted to a process tried in the years 1870-71, the plan being to neutralise the offensive gases as they ascend the ventilating shafts by the application of sulphurous acid; and whilst the cost has been far less the effect has been, as far as can be judged so far, satisfactory.

The new Volume of Proceedings of the Association of Municipal Engineers has just been issued, and is the most valuable that this Society has yet issued. Its contents include papers on the Floating Hospital of the River Tyne Port Sanitary Authority; Refuse destructors; Sewerage works of Luton, Maidstone, King's Lynn, York and Carlisle, and many other papers especially valuable to Municipal Engineers. As the Council of this Association have just notified that they are prepared to award premiums for papers contributed to future transactions, no doubt these volumes will continue to increase in value.

M. Eiffel still continues to meet with difficulties in the erection of the gigantic tower with which his name is associated. A further strike among the operatives engaged has taken place, the alleged reason being that owing to the great height at which they are required to work, and the corresponding danger involved, extra remuneration should be given. Should these difficulties continue it appears doubtful whether M. Eiffel



will be able to complete the huge undertaking by the 15th of January at which date he at present promises to complete it.

Many thousands of persons assembled on the landing stage and along the dockwalls of Liverpool a short time ago to witness the arrival on her last voyage of the *Great Eastern*. She was towed up the Mersey by two powerful tugs and was also using her own steam. The huge vessel was at once taken to Frammere and beached. The work of breaking her up is now being proceeded with. Messrs. Bath & Co., the owners, expect to realize much more than the £20,000 they gave for her by the sale of the iron and machinery.

A private trial was recently made of an electric dog-cart at the skating rink, Camden town. The vehicle, which has been constructed by Messrs. Immisch and Co., of Kentish town, for the Sultan of Turkey, presents the appearance of an ordinary four-wheeled dog-cart without shafts; it has seats for four persons, and beneath the seats are placed 24 accumulators, which supply the electricity to the motor, and which contain a charge sufficient to propel the vehicle for five hours at an average speed of 10 miles per hour on an ordinary track, at which rate the motor makes 1,440 revolutions per minute and develops a three-quarter horse-power. The steering is effected by means of an adaptation in the fore carriage. At the trial the carriage moved about very smoothly.

#### BURMA.

(From our own Correspondent.)

THE chief event during the past few weeks has been the unusual interest taken by Railway Engineers in watching the strain brought to bear on the embankments and bridges caused by heavy floods on the Toungoo-Mandalay section of the State Railway. Great uneasiness was at first experienced during the height of the floods, which have been unsurpassed for many years; but beyond slight damages to embankments, permanent-way, and a few days' block, nothing of special note happened. The floods have now partially subsided and communication is clear. The Myobinge and Mitugne bridges are now completed, and strenuous efforts are being made to push on the work of the Sinthay bridge, materials for which are being gradually brought by the canal boats; and from the progress now being made, it is anticipated that through trains will run before the end of the year. The whole line is now connected, barring the above bridge and a few minor bridges between Payinmana and Thabydaung, a distance of 111 miles. The mileage of the whole line is 386 miles and divided into 58 stations, in most of which the necessary buildings, &c., have been completed. Passenger traffic has been opened up to Pyinmana from the 25th September. Designs for new station houses for Rangoon and Mandalay are under preparation; both buildings will be constructed of blocks of laterite.

On dit that one of the chief causes that led to the Chief Commissioner's recent visit to Upper Burma was to make a personal inspection of the trade marts, and otherwise report on the necessity of carrying out the proposed extension of Railway beyond Mandalay; and we have every reason to believe that one of the urgent reforms pressed on the Supreme Government will be the early carrying out of this project. It is also rumoured that Mr. F. Bagley, one of Burma's most experienced Railway Engineers, assisted by a competent staff, will proceed next month to make the preliminary surveys.

The Survey Department has just completed a Map of Upper Burma. Triangulation was also effected over 23,500 square miles, on the scale of 4 miles to the inch. The following topographical surveys have also been completed on the same scale: Shan States, 10,000 square miles; Chindwin, Pagan, Yaw and Minbu, 7,600 square miles; Bhamo and Myadaung, 3,300 square miles. A great deal of geographical survey has also been completed. Mr. Ogle, of the Survey Department, who accompanied Mr. Needham's expedition to explore the routes from the Assam Valley, has submitted a valuable report, adding to the knowledge of the hitherto unknown country. He has also furnished a map embracing some 1,600 square miles of the country explored, between the Moo valleys and the Chindwin river.

The Forest Survey party has completed 7,087 miles of forest survey in Upper Burma with the plane table and chain. Traverses have also been made over with the same instruments and skeleton maps made of some 2,000 square miles. These surveys are being made preparatory to reservation. About 1,993

acres have been subjected to valuation linear surveys at the beginning of the year, but no working plans have as yet been made, till the forests are permanently demarcated.

The dispute between the Government and the lessees of the forests in Upper Burma has been settled by Dr. Ribbentrop, Inspector-General of Forests, during his recent visit to this Province. Under the settlement, the lessees retain their right to work the forests for the period as granted by the late King, which in the case of the Burma Trading Corporation, Limited (the largest lease holders) extends from 11 to 14 years, paying an *ad-valorem* rate on each log of teak obtained, instead of a lump sum paid in advance; and it is estimated that a revenue of 10 or 11 lakhs will thus be derived annually. The outturn of teak from the forests in Upper Burma during the year 1887-88 was 44,441 tons, of which 27,000 tons were extracted from the Pyinmana Forests, which are the largest teak forests in Burma. During the late visit of Dr. Ribbentrop, he arranged a scheme for the proper management and working of the forests in Upper Burma, and for this purpose Divisional and Sub-Divisional charges have been organized and nurseries instituted.

Up to the present time the Coal Prospecting Company, to the north of Thayetmyo, have not met with the success they deserve. From tests and experiments conducted the quality of the outcrop coal was found to be mixed largely with stone and other foreign substances; it has therefore been proposed to thoroughly explore the field by means of the rod.

The Irrawaddy Flotilla Company are now negotiating for the lease of the coal-mines in Upper Burma, and for this purpose one of their employes was lately deputed to Upper Burma to explore and report upon the coal-mines. We learn that attempts have been made to work the mines in the late King's incumbency, as several shafts or pits are sunk which are said to have been worked under the direction of an Italian Engineer. As many as 20 borings are executed, varying in depths from 20 to 45 feet, but it is believed that the main cause of the failure to work the mines was the difficulty in securing experienced labor for sinking work.

The Rangoon Municipality are now moving the Government to sanction the raising of a further loan of 7 lakhs to supplement the 23 lakhs already secured, to finally complete the estimate for the new drainage system. Progress in this direction has been greatly impeded by the rains, but from arrangements now being made by Messrs. Shone and Ault's Engineers, supplemented with the cessation of the rains and the large amount of material in stock, we are confidently assured that the work will be completed before the contracted time.

The importance of securing a paid President for the Rangoon Municipality is now engaging the serious attention of the Town Council, and with this view application has been made to the Local Government; and as the subject has been favorably reviewed by the authorities, there is hope of obtaining a Civil Servant at the head of affairs, who will devote his whole time to Municipal affairs.

## Official Papers.

### PUBLIC WORKS DEPARTMENT, BOMBAY.

Bombay Castle, 10th October 1888.

No. 57.—The following is published for general information:—  
"No. 417 E.—1727 of 1888.

EXTRACT from the Proceedings of Government in the Public Works Department, dated 10th October 1888.

Read:—

Letter from the Government of India, No 108 G., dated 17th January 1887.

Letters to the Government of India—

No. R., dated 20th May 1887.

No. W., dated 24th May 1887.

Letter from the Government of India, No. 1564 G., dated 12th August 1887.

Letter to the Government of India, No R.—2, dated 8th September 1887.

Letter from the Government of India, No. 531 G., dated 6th March 1888.

Letter to the Government of India, No. 197 E.—856, dated 14th May 1888.

Letter from the Government of India, No. 1381 G., dated 12th June 1888.

Letter to the Government of India, No. M.—24, dated 21st June 1888.

Letter from the Government of India, No. 2071 G., dated 14th August 1888.



Telegram to the Government of India, dated 13th September 1888.

Telegram from the Government of India, dated 22nd September 1888.

**RESOLUTION.**—The Governor in Council is pleased to notify that, whereas the appointment of Secretary to Government in the Public Works Department has hitherto been held by the senior Chief Engineer on the Establishment, it has now been decided, with the sanction of the Government of India, that the appointments shall in future be separate, and that the Chief Engineers and professional advisers of Government shall be relieved, as far as possible, of purely administrative (non-professional) duties, and kept in direct touch with the Engineering operations of the Divisions to which they severally belong.

2. In all matters of professional detail, the Chief and Superintending Engineers will be the advisers of Government for matters within their respective Divisions, and their advice and opinion on such matters will not be liable to be criticised or over-ruled by the departmental Secretary, who will ordinarily be their junior.

3. Selection for the post of Secretary will be made from the Engineering Establishment list, with special reference to administrative qualifications.

4. There will, in addition, be a Joint (or Under) Secretary, appointed by selection in the same manner, and it will be arranged that either the Secretary or Joint (or Under) Secretary shall be experienced in questions of Irrigation administration.

5. There will be four Officers in charge of Divisions, two of whom will be graded as Chief Engineers and two as Superintending Engineers. Subject to such orders as Government may be pleased to issue in any particular case, each will be in independent professional charge of his Division and exercise the powers of a Chief Engineer, as described in the Public Works Code, Chapter III., paras. 1–23. Thus, under para. 1, the two Superintending Engineers will exercise in their own Divisions the powers of a Chief Engineer, and, under para. 22, the Chief Engineers will perform the duties of Superintending as well as Chief Engineers.

6. The following is a summary of the powers which will thus be exercised (but, as regards expenditure, only within the limits of the Budget grants concerned) by each of the four Officers in charge of Divisions:—

(a.) *General Control*—

To exercise general control over the Engineering operations of the Division to which he belongs, and a concurrent control, with the Examiner of Public Works Accounts, over the duties of the Officers of the Department in connection with the accounts of expenditure.

(b.) *Designs and Estimates*—

To deal finally with the details of designs and estimates of all projects.

(c.) *Emergent Works or Repairs*—

To sanction the commencement of any urgently required work to the extent of Rs. 2,500, reporting the fact forthwith to Government.

(d.) *Contracts*—

To accept any tender for the execution of work by contract within the limits of the amount of the sanctioned estimate, provided that the sum in each case does not exceed Rs. 20,000.

(e.) *Subsidiary Works for large Projects*—

To sanction all subsidiary works and operations connected with large projects other than Productive Public Works, the cost of which is covered by lump sum sanctions to the extent of Rs. 500 for each work.

(f.) *Alterations of Design*—

To sanction necessary alterations in the constructive details of works during their execution, provided that no increase of charge to the amount of more than 5 per cent. above the estimate, shall be caused by such alterations.

(g.) To suspend the commencement or progress of any work, pending orders of Government.

**REPAIRS.**

(A.) To sanction estimates for current and special repairs within the limits assigned for their Divisions in the Budget-Estimates under each head of Service.

(i.) To sanction emergent repairs to Irrigation or other works to any reasonable and necessary amount, in case of imminent danger to the structure.

(j.) To appropriate from the lump sum grant for repairs placed at their disposal to such repairs as they may think fit to sanction.

(k.) To fix the rent to be recovered for occupation of public buildings.

**ESTABLISHMENT.**

(l.) *Appointments*—

To appoint to sanctioned posts, or within sanctioned limits, Lower Subordinates (if authorised to do so) and Office and petty Establishments, and in the case of temporary Establishment Upper Subordinates.

(m.) To grant leave of any kind, subject to the Civil Leave Code, to officers whom they are empowered to appoint, and privilege leave to any other officer, if specially empowered to do so.

(n.) *Transfers*—

To transfer and post within their Divisions, Assistant Engineers and members of the Subordinate Establishments.

(o.) *Punishments*—

To Oversee and members of the Lower Subordinate, office and petty Establishments.

(p.) *Dismissals*—

To dismiss any person appointed by a Chief Engineer or any lower authority.

(q.) To fix the head-quarters of Executive and Assistant Engineers.

**TOOLS AND PLANT.**

(r.) To pass indents on other Departments for articles required for sanctioned works.

(s.) To issue orders for the disposal of all unserviceable or surplus stores.

7. As regards the relations between the several Chief and Superintending Engineers, each will, as stated in para. 5, and subject to the reservation therein contained, be in independent professional charge of his Division, but Government reserve the right, on occasion, to refer Irrigation projects or questions comprising dubious points for irrigational settlement, for the opinion of any one of the four officers who may possess special experience in irrigational or hydraulic works.

8. To secure uniformity, in respect to such matters in which its attainment is desirable, the Chief Engineers and Superintending Engineers will meet, whenever Government deems it necessary to obtain their joint advice."

*By order of His Excellency the Right  
Honorable the Governor in Council,  
W. S. HOWARD,  
Acting Secretary to Government.*

**PUBLIC WORKS DEPARTMENT, INDIA.**

Read again—

Circular letter No. 2048G., dated 14th October 1887, regarding the prospects of promotion to the superior grades of the Department.

Read—

Replies from the several Local Governments and Administrations to that circular.

**OBSERVATIONS.**—In the circular letter quoted in the preamble it was shewn that, owing to the small number of superior posts in the Department compared with the total strength, only a small proportion of the officers employed could ever hope for promotion to the highest appointments. Consequently, it was pointed out that, to secure the appointment of the best officers to those posts, it is necessary to exercise a strict system of selection as opposed to that of pure seniority in promoting officers to the higher grades.

2. To attain this end three proposals were put forward in that letter—

*First.*—That separate rosters of men selected or rejected for the Superintending Engineer class should be prepared and maintained by Local Governments and Administrations.

*Secondly.*—That a further selection should be made by the Government of India from those rosters.

*Thirdly.*—That the men so selected should be appointed to the higher posts on the several Provincial and other lists irrespective of the particular list to which they had hitherto belonged.

3. After consideration of the replies received from Local Governments, the Government of India has come to the conclusion that the third proposal cannot practically be carried out as a general rule, and may be abandoned; but this will not prevent such transfers being carried out, as at present, when desirable on special grounds. The other two proposals will be adopted, and in future the principle of selection advocated in the circular will be carried out with the utmost strictness, in regard to promoting officers to the rank of Superintending and Chief Engineer and posts of corresponding rank.

4. It is therefore necessary that all Local Governments and Administrations should be especially careful in maintaining a continuous record of character to enable them to make proper recommendations regarding officers of the rank of first grade Executive Engineer and above. A Register will also be maintained of all such recommendations in the office of the Secretary to the Government of India, Public Works Department, and the selections for promotion will be mainly made on the recommendations contained in the register. In order to render this register effective, it is necessary that the recommendations so sent up should be very carefully considered, and be made more full and complete than is the case at present. The assistance of Local Governments and Administrations is particularly invited in order to bring this about, and the following instructions are promulgated with the same object.

**RESOLUTION.**—On the 1st of January next and every succeeding year, recommendations should be carefully prepared in full, and without reference to any previous reports that may have hitherto been sent up, concerning all Executive Engineers in the first grade, whom the Local Government considers fit for promotion to Superintending Engineer. Each Local Government will also furnish a list, not necessarily containing any remarks, of the men in the first grade of Executive Engineers whom it considers unfit for promotion to the rank of Superintending Engineer.

2. The recommendations regarding the selected men should be made under the following four heads:—

- |                   |              |
|-------------------|--------------|
| 1. Professional   | 3. Personal. |
| 2. Administrative | 4. General.  |

3. A register of such recommendations should be kept up by the Local Governments as a continuous record of the officers' characters and qualifications, in order to facilitate the preparation of subsequent recommendations.

4. The recommendations sent forward to the Government of India should be recorded on a separate sheet for each man. It is not necessary that these recommendations should be drawn up in any particular form. All that is necessary is that the name and rank of each officer should be stated on the sheet, that the information required in paragraph 2 should be clearly given, and that the document should be signed in full by the officer who prepares the recommendation for the acceptance of the Head of the Administration.

5. The Government of India will maintain registers of the recommendations so forwarded, and by their help will prepare a roster of men selected for promotion to Superintending Engineer.

6. Similar recommendations should be furnished of officers who are already Superintending Engineers, in regard to their fitness for promotion to the post of Chief Engineer.

7. No recommendations, unless specially asked for, need be furnished regarding officers who are already substantive Chief Engineers.

8. It is requested that the recommendations sent up under these orders may be submitted to the Head of the Local Government or Administration, and the fact of his concurrence in them invariably



recorded. In the case of Superintending and temporary Chief Engineers who are Secretaries to Local Governments or Administrations, the recommendation should be made by the Head of the Administration himself in the covering letter.

9. Recommendations regarding Consulting Engineers for Railways should be prepared in the office of the Secretary to the Government of India, Public Works Department, for entry in the register after approval by Government.

10. It will be the special duty of the Director-General of Railways and of the Inspector-General of Irrigation to bring to the notice of the Government of India any special information, as to the character of officers, which they may obtain on their inspection tours and with the consent of Government to have such report entered in the register.

## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

Burma, October 6, 1888.

Mr. P. B. Roberts, Executive Engineer, 2nd grade, on special duty at Slwebo, was granted one month's privilege leave, with effect from the forenoon of the 8th September 1888.

With the approval of the Government of India, the Chief Commissioner sanctions the formation of a separate division under the Superintending Engineer, 1st Circle, to be called the Special Defences Division with head-quarters at Rangoon. This division will for the present undertake the construction of all coast and harbour defences throughout the province, as well as subsidiary buildings in connection therewith.

The following officers are transferred from the Rangoon Division to the Special Defences Division from this date :—

Lieutenant W. R. Morton, R.E., Assistant Engineer, 1st grade, to have charge.

Lieutenant W. S. Hunter, R.E., Assistant Engineer, 2nd grade.

Lieutenant W. R. Morton, R.E., Assistant Engineer, 1st grade, arrived at Calcutta on the forenoon of the 27th September 1888 and reported himself at Rangoon on the forenoon of the 1st instant on return from three months' special Burma privilege leave granted to him in Burma Public Works Department Notification, dated the 18th June 1888.

Madras, October 9, 1888.

The following intimation, received from the Secretary of State, is published :—

Major D. McNeil Campbell, R.E., Executive Engineer, 1st grade, Madras, is permitted to return to duty within period of leave.

Bombay, October 11, 1888.

The following promotions are ordered :—

Mr. C. N. Clifton to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 10th March 1888, *vice* Mr. G. O. W. Dunn, who reverts to Executive Engineer, 4th grade, on proceeding on furlough.

Mr. W. L. S. L. Cameron to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 21st March 1888, *vice* Mr. T. Summers, who reverts to Assistant Engineer, 1st grade, on proceeding on furlough.

Mr. A. E. Hight to Executive Engineer, 4th grade, with effect from 23rd May 1888, *vice* Mr. Cameron, who reverts to Assistant Engineer, 4th grade, on proceeding on furlough.

Mr. R. Barnes, Assistant Engineer, 2nd grade, has passed an examination in Colloquial Marathi.

Mr. A. W. Shepard, Assistant Engineer, 2nd grade, has passed the Departmental Examination.

Punjab, October 11, 1888.

Mr. T. Macpherson, Honorary Assistant Engineer, on re-transfer from the Simla Imperial Circle, is posted to the Simla Provincial Division.

#### Irrigation Branch.

Mr. J. J. Mullaly, Executive Engineer, 2nd grade, took over Executive charge of the 1st Division, Bari Doab Canal, from Major J. F. J. Miller, Executive Engineer, 1st grade, on the afternoon of the 9th September 1888, and the latter officer proceeded on the one month's privilege leave granted in Irrigation Branch Memo., dated 5th September 1888, on the forenoon of the 10th idem.

India, October 13, 1888.

The following Assistant Engineers, 2nd grade, appointed by Her Majesty's Secretary of State for India in Council from the Royal Indian Engineering College, who have gone through a course of practical training in England, are posted as follows :—

#### To Madras.

Mr. Hugh Trowbridge Keeling Charles Mildred.

#### To Bombay.

Mr. Ernest Oscar Mawson.

#### To Bengal.

Mr. Augustus Henry Charles MacCarthy.

Mr. Bernard Heaton.

#### To North-Western Provinces and Oudh.

Mr. William Richard Williams.

Mr. Alfred Bonner Gale.

#### To Punjab.

Mr. Harry James Eldridge.

Mr. Richard Walsingham Western.

#### To Burma.

Mr. Arthur Gordon Rose Trapmann.

Mr. Harry Cecil Jones.

#### To State Railways.

Mr. Harry Augustus Fred Currie.

Mr. Edward Campbell Herbert.

Mr. Charles Dundas Dove Wilson.

Mr. Francis Villiers Tayler.

With reference to public Works Department Notification, dated 12th October 1888, the services of the undermentioned Assistant Engineers, 2nd grade, are placed at the disposal of the Director-General of Railways :—

Mr. H. A. F. Currie.

Mr. E. C. Herbert.

Mr. C. D. D. Wilson.

With reference to Public Works Department Notification, dated 12th October 1888, the services of Mr. F. V. Tayler, Assistant Engineer, 2nd grade, are placed at the disposal of the Government of Bengal.

The following reversions are ordered with effect from the 1st October 1888 :—

Mr. H. F. Storey from Superintending Engineer, 1st class, temporary rank, to Superintending Engineer, 2nd class.

Mr. J. R. Bell from Superintending Engineer, 2nd class, temporary rank, to Superintending Engineer, 3rd class, sub. *pro tem.*

Mr. R. C. Dyson, Executive Engineer, 4th grade, temporary rank, State Railways, is appointed to officiate as Deputy Consulting Engineer for Railways, Bombay.

Captain W. Pitt, R.E., Executive Engineer, 2nd grade, sub. *pro tem.*, State Railways, is transferred to the Superior Revenue Establishment of State Railways in Class II, sub. *pro tem.*, and appointed Deputy Manager of the North-Western Railway.

The services of the undermentioned officers are temporarily placed at the disposal of the Military Department for field service :—

Captain H. E. S. Abbott, R.E., Executive Engineer, 3rd grade, Punjab.

Lieutenant R. S. MacLagan, R.E., Assistant Engineer, 1st grade, Punjab.

Honorary Lieutenant and Deputy Assistant Commissary James McCauley, Sub-Engineer, 1st grade, sub. *pro tem.*, State Railways, is promoted to Assistant Engineer, 2nd grade, with sub. *pro tem.* rank in the 1st grade, with effect from the 11th April 1888.

Mr. Von Ahn, Executive Engineer, 3rd grade, Central India, is on return from furlough, placed at the disposal of the Government of Madras for employment on Railways in that Presidency.

Mr. P. P. Rogers, Assistant Engineer, 1st grade, State Railways, is, on return from furlough, placed at the disposal of the Government of Bengal.

#### Director-General of Railways.

Mr. C. H. Croudace, Executive Engineer, 1st grade, is transferred, in the interests of the public service, from the North-Western Railway to the Great Western of India Railway Survey.

#### North-Western Railway.

Mr. C. F. Sykes, Assistant Engineer, 1st grade, passed, on the 1st October 1888, the Lower Standard Examination in Hindustani.

Bengal, October 17, 1888.

#### Eastern Bengal State Railway System.

Lieutenant C. H. Cowie, R.E., Assistant Engineer, 1st grade, passed the Departmental Standard Examination on the afternoon of the 6th October 1888.

## Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act V. of 1888, in the Office of the Secretary to the Government of India in the Revenue and Agricultural Department :—

The 29th September 1888.

8 of '88.—James McCulloch, of Manchester, England, Engineer. —For improvements relating to valves and valve gear, chiefly designed for rock drills.

10 of '88.—Robert Cooper, Herbert Fitzroy Clayton and George Holden Hordroyd, all of Huddersfield, England, Dry-sinters. —For improvements in filtering apparatus.



33 of '88.—Arthur Andrews, Merchant, of No. 3, Elysium Row, in the town of Calcutta.—For improvements in the metal package suitable for the packing, storage and carrying of tea and other substances of a like nature known as "Andrew's Patent Metal Tea-chest."

38 of '88.—James Samuel Burroughes, of the firm of Burroughes and Watts of Soho Square, London, in the County of Middlesex and Kingdom of England, Billiard Table Manufacturer.—For improvements in the construction of Billiard Tables.

Specifications of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Revenue and Agricultural Department :—

9 of '88.—Claude Grivolais fils, of Paris, France, Electrical Engineer.—For improvements in electrical indicating or signalling apparatus.

48 of '88.—Samuel Cleland Davidson, of Sirocco Works, Belfast, Ireland, Merchant.—For improvements in the manufacture of boxes or chests in which to pack tea or other substances for storage or transit and in apparatus to be employed in the manufacture.

73 of '88.—The Phillip-Stephen Photo-litho and Typographic Process Company, Limited, a registered Company of the Colony of New South Wales, whose office is at 155, Clarence Street, in the City of Sydney and said Colony.—For improvements in photo-lithography, photo-engraving and other photo-illustrative processes.

118 of '88.—William Henry Sinnatt, of the City of Manchester, England, Manager of Works.—For improvements in stoppers for bottles and other vessels.

140 of '88.—James Williamson Wallis, Planter, residing at 4th Avenue and 23rd Street, Birmingham, in the County of Jefferson, State of Alabama, United States of America.—For picking cotton.

151 of '88.—William Drummond Chase, Manufacturer of clock specialties, a resident of Hackensack in the County of Bergen and State of New Jersey, United States of America.—For improvements in clocks.

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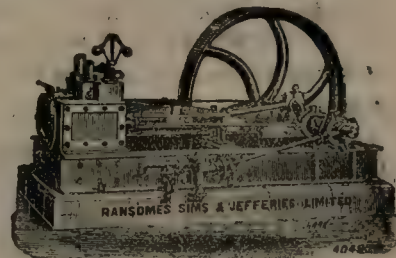
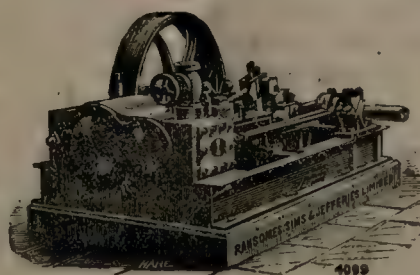
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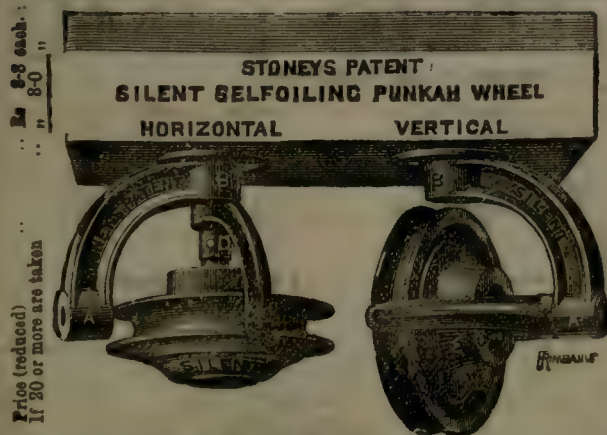
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General correspondence, and all communications bearing upon literary matters, should, as heretofore, be addressed to PAT. DOYLE, C.E., Spence's Hotel, Calcutta.

It is particularly requested that all letters on business concerning subscriptions and advertisements be addressed to the "Managing Agents," MESSRS. BALMER, LAWRIE & Co., 103, Clive Street, Calcutta; and all remittances be made payable to them.

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# INDIAN ENGINEERING.

SATURDAY, OCTOBER 27, 1888.

## FAMINE PROTECTIVE LINES OF RAILWAY IN SOUTHERN INDIA.

THE Governor of Madras said the other day publicly that the Government of Madras is suffering from the consequences of his predecessors' thoughtless mistakes. Those who made the alignment of the Madras Railway, he said, "seem to have taken the precaution of avoiding all the populous centres as much as possible, and to have imagined that the line would pay better by passing through jungles instead of through towns." His Excellency added that, in his official capacity, he is not responsible for the making of railroads. Is anybody now-a-days? Local Self-Government theories have a tendency to go down below zero, when anything really practical is on the tapis.

The Madras Chamber of Commerce protested abundantly against the nervous dread of the neighbourhood of large towns—possible head centres of sedition—which dominated the action of the authorities who held control over the construction of the Madras Railway. To no purpose. And it is written :—

Unfortunately, the mistake is one that cannot now be repaired at a cost which the Secretary of State could be reasonably expected to sanction; and the line must continue to suffer from causes over which it has no control, but for which the Government is confessedly responsible. The position must therefore be accepted, but the Chamber desires to respectfully suggest that the frank recognition of the unfortunate error of judgment of the over-ruling local authorities of upwards of a quarter of a century ago should tend to make the present Government pecuniary desirous of exerting the influence at its command to prevent any gratuitous addition to the serious drawbacks against which the Madras Railway has already to contend.

There is a proposal to the fore for amalgamation between the South Indian Railway Company and the Cuddapah-Nellore State line; but it does not seem to meet with much popular approval. The Chamber of Commerce's objections to it are thus formulated :—

It is, I trust, superfluous for me to state that the Chamber regards the two Railway Companies whose field of work lies within this Presidency with the utmost impartiality; and that it is opposed to the idea of extending any invidious preference to either of them. There is room in the Presidency for the full employment of both systems, and the Government appears to have succeeded hitherto in so apportioning the territory served by each, that the extent of the work done by the two lines is now remarkably even. Thus, in 1886, the Madras Railway Company carried 6,374,718 passengers and the South Indian Railway Company carried 6,509,963.

The Chamber cannot, therefore, view with unconcern a policy that proposes to allow the southern Company to intrude upon and divert, by preferential rates or otherwise,



the traffic obtainable in what has hitherto been considered the special territory of the northern Company, and to encourage that traffic to find its outlet either at the French port of Pondicherry or the British port of Negapatam, instead of at its more natural destination namely, the port of Madras, at which a harbour is now being constructed at great cost to the State. The Chamber has been committed, since 1873, to the opinion that the trade of this port is capable of yielding, without undue pressure, a revenue in harbour dues sufficient to pay interest at the rate of 4 per cent. per annum on a capital expenditure of £565,000; but if the negotiations under reference are carried out as originally proposed, the Chamber will be compelled to modify its opinion of the revenue prospects of the harbour.

We are told that completion of the metre line of the Southern Mahratta Railway from Guntakul to the Portuguese port of Marmagoa is already tapping much of the traffic in cotton and other staples of the Bellary district hitherto ordinarily brought by the Madras Railway for shipment at that port.

Moreover, that extension of a metre gauge line from Guntakul, *via* Dharmavaram to Hindupur, whence an extension to Bangalore must be merely a question of time, is within cognizable, practical purview. Upon the admittedly "disastrous" results likely to ensue to the Madras Railway as consequences of these new departures, the Report we have in hand looks complacently, without any *arriere pensee*. Probably INDIAN ENGINEERING can afford to do likewise. We make no pretension to sporting proclivities, and *ergo* Railway tracks conducted through jungles and avoiding commercial centres do not commend themselves to our appreciation of right, and amenability to right reason.

It is suggested that the large tract of country bounded by the Southern Mahratta Main line, and the Bellary-Kistna Railway to the north, by the Coromandel coast to the east, and the Malabar coast to the west, might have been reasonably regarded as a proper field of labor for the Madras Railway Company, while the area south of the south-west line of the Madras Railway might continue to be assigned to the South Indian Railway Company. Modern competition blows all such paper cut and dried arrangement with nothing, into nothingness, holds fast to a healthy system of competition. And prevails. *Et praevaleret*.

The good days of monopolists are overpast, and except under the exceptional unofficial handling of Public Works Department dummies like Sir Charles Elliot, are not likely again to afflict this generation.

We note that His Excellency the Governor of Madras has put in print his opinion that in the absence of any inducement to traffic through the exercise of undue preference to leave the shorter route to the coast the harbour of Madras will, unless burdened by exorbitant charges, outweigh such of the impediments due to a single break of gauge as are inevitable, and will secure to Madras the export trade to which its geographical position is so distinctly favorable.

## SANITATION IN BENGAL.

DURING 1886-87 the Sanitary Commissioner of Bengal inspected 39 provincial towns, with Municipal Corporations attached to their importance. But he can only report three of them—Burdwan, Darjeeling and Sahebgunge—as "in fairly good condition." So much for the uses of lokil sluff on its conservancy sides. A steady fall from year to year in the number of official and European members on the Committees, consequent on introduction of the elective system, is noted. This statement ought to be read probably in connection with the one we have antepenuitimately quoted.

The chief differences in expenditure, as compared with the previous year, are:—

<i>Increase.</i>		Rs.
(1) General establishment and collection charges	14,422	
(2) Lighting	12,650	
(3) Repairs to markets, dispensaries, &c.	7,062	
(4) Water-works	59,366	
(5) Road-cleaning establishment	21,725	
(6) Drainage works	19,595	
(7) Markets, slaughter-houses and public gardens	14,643	
(8) Other charges under "Public convenience"	6,557	
<i>Decrease.</i>		
(9) Buildings and other works	6,323	
(10) Road-watering	3,458	
(11) Conservancy	3,351	
(12) Public instruction	4,230	
(13) Contribution to local or provincial funds	4,491	
(14) Miscellaneous	90,929	

The increase under the heading "Drainage Works" is a commendable improvement on the past; but is open to a good deal of expansion still. In only two Municipalities is a water-tax levied—Burdwan and Darjeeling. These, it will be remembered, are two of the three accorded by the Sanitary Commissioner the honour of being reported "in fairly good condition." With the exception of the money spent on water-works by Burdwan and Darjeeling; Rs. 14,643 devoted to markets, slaughter-houses, and public gardens; and Rs. 7,062 to repairs, nothing more seems to have been spent in the Engineering line.

Several fires occurred during the year, causing considerable damage to property and loss to the mercantile community, especially in the Municipality of Gobaridanga, where about 500 houses and 84 sugar manufactories, full of sugar and molasses, were burnt down. The total loss was estimated at Rs. 2,50,000. The Municipal Commissioners did much to alleviate the distress of the sufferers. The Culna Municipality suffered to the extent of Rs. 56,000 from the fire which broke out on the 16th March 1887 and raged for some hours, notwithstanding all the efforts of the Commissioners and the police to put it out. Five hundred and eighty-four thatched and 27 masonry houses were destroyed. In the Baidyabati Municipality the lives of three women were lost, and about 100 houses were destroyed by the fire which took place on the 24th March 1887. The Municipal Commissioners tried in vain to arrest the progress



of the fire. The estimated loss was Rs. 50,000. The floods also did a good deal of damage to roads, drains and houses in the Municipalities of Nuddea, Naraingunge, Purneah, Brahmanberiah, Furreedpore, and Coomerkhally.

#### BRAKE TRIALS ON FRONTIER RAILWAYS.

THE Delegates of the Railway Conference have returned from Quetta having had their outing to the Frontier at the expense of the Government of India. They spent four days altogether in the neighbourhood of Quetta conducting experiments with two descriptions of automatic brakes (Vacuum and Westinghouse), which had been carried out hundreds of times before in England and which left the relative merits of the two systems in exactly the same position as before. Both descriptions of brake in the hands of experts sent by the rival companies acted admirably. The Westinghouse is said to have beat its former record in having stopped a train equivalent to 52 ordinary vehicles running down a gradient of 1 in 100 at a speed of 33 miles an hour in a distance of 75 yards. The Vacuum brake does not profess to be able to stop long trains without the addition of numerous inlet valves throughout the train, and not having had these valves fitted did not attempt to handle this length of train. With the equal lengths of trains tried running down gradients of 1 in 40 the Westinghouse also showed its superiority pulling up in a much shorter distance. This seems due to the comparative slowness with which the Vacuum brake acts. The two brakes were tried on the Bolan railway to test their powers of controlling speeds down long inclines. In these trials while both brakes did the work efficiently the Vacuum kept the speed somewhat steadier than the Westinghouse.

It is understood that the Delegates have not come to any definite conclusion, and as both brake companies are willing to have extended time trials it seems desirable that each should be tested for a year in the hands of the drivers working ordinary trains and with all the variations of climate and exposure to dust, cold, and heat, which are to be had on the frontier railways of Biluchistan. The advocates of the Westinghouse brake assert that the India rubber piston packings and washers of the Vacuum will not stand great heat and that as an inward rush of air takes place when the brakes are applied much dust and grit will enter the tubes and valves and quickly injure them, while friends of the Vacuum brake state that the "triple valve" will assuredly give trouble. Nothing under a year's experience of both will decide these points.

THE REGISTRATION OF PATENT AGENTS.—The following clauses are those in the Bill entitled, "An Act to Amend the Patents, Designs, and Trade Marks Act, 1883," which refer to the registration of patent agents:—(1) After the 1st day of July 1889, a person shall not be entitled to describe himself as a patent agent, whether by advertisement, by description on his place of business, by any document issued by him, or otherwise, unless he is registered as a patent agent in pursuance of this Act. (2) If any person knowingly describes himself as a patent agent in contravention of this section he shall be liable on summary conviction to a fine not exceeding £20.

#### Notes and Comments.

SCIENTIFIC RESEARCH.—A meteorological observatory has been opened under the auspices of the Government of India at Baghdad.

A WISE CHANGE.—From 1st January next the Bengal Central Railway will be worked independently of the Eastern Bengal State Railway system, Mr. Carey, the present Chief Engineer, being Manager.

THE BURAKUR IRON-WORKS.—We are sorry to learn that the proposal recently made by a Home 'Syndicate to purchase the Bengal Iron-Works is likely to fall through. The offer made was ridiculous—showing gross ignorance, or rather palpable miscalculation.

MYSORE AGRICULTURAL EXHIBITION.—The first Agricultural Industrial Exhibition ever held in the Mysore province was opened on the 17th instant in Mysore by the Maharaja. There were present nearly 20,000 people. Thirty thousand exhibits were shewn.

IRRIGATION OPERATIONS OF THE YEAR 1887-88 IN BENGAL.—The Annual Statement in acres of crops irrigated by canals in Canal Divisions in Bengal shews a total for 1887-88 of 488,542, against a total for 1886-87 of 417,821. No less than 390,116 acres of the former figure is due to rice cultivation.

NATIVE CONSISTENCY.—By way of making its patriotism manifest the Executive Committee of the National Congress has indented on an English manufacturer for a thousand chairs. And the Congress professes desire to further the development of native arts and trades! Are there no Indian carpenters capable of chair making?

OFFICIAL MORALITY.—It is whispered that the Audit Code of the E. I. R. was coolly appropriated by a certain Provincial State Railway in Bengal, and the outcome of this wholesale copying was some ludicrous mistakes which led to the detection of the "piracy." The E. I. R. authorities have, we hear, referred the question of "copyright" to Government.

THE MADRAS HARBOUR.—The Engineer of the Madras Harbour Works has prepared plans and estimates for the north-east entrance of the Madras Harbour. These have been approved by the Harbour Trust, and Government have been asked to wire to the Secretary of State to postpone sanction to any design for the entrance, pending receipt of the Board's proposals.

COAL PROSPECTING IN RAJMAHAL.—We learn that the Government of Bengal intend testing the Rajmahal coal-fields by a deep boring at a site to be selected by Dr. King. The bore-hole will be carried down to a depth of 500 feet. The work has been entrusted to Messrs. Atkinson Brothers who have engaged the services of Mr. T. Forster, M.E., F.G.S., to superintend the operations.

PROGRESS INDIA!—On the third day of the month *Ashin*, lately departed, a meeting of Bengal Pundits was held to consider what steps ought to be taken to rectify mistakes in current Bengali Almanacs, and to bring them "into a tolerable state of uniformity"—some approximation to scientific verdicts finding favor in Europe. This seems to us a hopeful sign of the times.

SEEBPORE ENGINEERING COLLEGE.—A correspondent to the *Indian Mirror* (19th October) is of opinion that the Engineering College at Seebpore "imparts a very meagre sort of technical education." Perhaps the autho-



rities concerned will take the hint. Meanwhile hasty critics should remember that interest in technical education is quite a new thing, a somewhat inchoate perception as yet.

**THE DELHI-KALKA RAILWAY.**—It is now definitely settled that Mr. R. A. Way, Executive Engineer, P. W. D., who is now serving on the Bengal-Nagpur Railway as Superintending Engineer, Eastern Section, will be the Chief Engineer of the Delhi-Kalka Railway. Mr. Way is already directing the operations of the survey, and has appointed Mr. H. Graves to carry out the same as Engineer-in-charge, *pro tem*.

**ASSAM PETROLEUM.**—Mr. Townsend, the expert, as the result of a recent examination of petroleum deposits in the Upper Assam Valley, made by orders of the Government of India, gives a glowing account of the prospects. He is even hopeful enough to suggest that "the time may not be far distant when we may be able to put American and Russian kerosine out of the Eastern markets by an equally good article of home production."

**THE GLASGOW EXHIBITION.**—From the opening day of the Glasgow Exhibition up to 26th September 4,113,966 persons had passed the turnstiles. We have been hearing lately about Exhibitions being played out, and altogether unattractive. These figures do not bear out such conclusions. But then M. Joubert is not in charge of the Glasgow Exhibition, which by all accounts seems to be a remarkably well ordered performance. We are glad that India is fairly well represented at it.

**BURMA.**—Mr. G. F. Berrill, Sub-Engineer and Honorary Assistant Engineer, has been appointed to the charge of the 4th Division of the Toungoo Mandalay Railway extension *vice* Mr. Wiseman, Executive Engineer, who has taken privilege leave. Mr. J. D. Harris who was employed as a temporary Upper Subordinate on the Toungoo Mandalay extension will, on his services being dispensed with by the Railway, be re-entertained on the Burma Provincial Establishment as a temporary Assistant Engineer.

**THE EASTERN TELEGRAPH COMPANY.**—The accounts of Eastern Extension, Australasia, and China Telegraph Company, Limited, for the half-year ended 30th June, shew, subject to audit, a profit balance of £79,153, after payment of the interim dividend for the first quarter, and charging the cost of the completion of the Singapore-Saigon cable renewal, amounting to £15,401. The Directors have declared a dividend for the quarter ended 30th June of 2s. 6d. per share, tax free, payable on the 16th October, carrying forward £47,903.

**NERBUDDA COAL AND IRON COMPANY.**—At a meeting of the Nerbudda Coal and Iron Company (Limited) held on the 25th ultimo in London, it was stated that the result of the working of the Company during the past six months was such that the shareholders should regard the result of the six months' working as satisfactory, especially remembering that they are recovering from a serious accident which might have caused the annihilation of the Company, which occurred under the Management now guiding the destinies of Umaria and Warora.

**OFFICIAL PHRASEOLOGY.**—What is the precise meaning of the word "interesting?" What is described as an *interesting* feature in the construction of wells in the North West-Provinces is thus focussed in the last Government Review of Court of Wards management of

estates thereaway:—"At Orerman, one well was in course of construction: 15 feet only of the cylinder had been sunk when the shaft gave way, owing to the sand and the rains, and buried the cylinder altogether. Total expenditure to 30th September 1887, Rs. 230-6-11."

**ACCELERATED MAIL SERVICE BETWEEN CALCUTTA AND BOMBAY.**—A weekly connection with the P. and O. Mail Service has been arranged for between Calcutta and Bombay. This train will start slightly early and will not stop except for Locomotive purposes. A dining and Pullman car will be attached to the train, which will arrive in Bombay in sufficient time to catch the Mail Steamer. In this way a day would probably be saved and would enable letters received by one mail being answered by the next. This arrangement will come into force early next year.

**LOCAL INDUSTRY.**—The Singapore shipbuilding trade has been hard hit by a measure just passed by the Netherlands Indian Government, in the interest of local industry at Batavia. Until very lately, it had been the custom to build at Singapore all small steamers required by that Government for official purposes in the outlying settlements. As might have been expected, objection was raised, on patriotic grounds, against spending money in favoring foreign trade, and neglecting to encourage local enterprise in the same line. Liberality of this kind has not been unknown here too.

**AN ACKNOWLEDGMENT.**—We have been favored with the following official papers:—(1) Circular letter No. 2535 G. of 1888 to Local Governments, &c., *re* preparation of recommendation rolls of officers serving on lists the promotions on which are made by the Government of India. (2) G. of I. Resolution No. 2591 G., dated the 6th October 1888, *re* necessity of a strict system of selection for the superior posts of the P. W. Department. We may say that these papers were received by us some days after one of them had appeared in the columns of the *Pioneer*, so that we have to be thankful for small favors.

**FRONTIER DEFENCE.**—Schemes have been under consideration for some time past for placing the North-Western Railway in a position to meet a heavy troop movement in the event of it becoming necessary to collect a large army on our frontier at any time, and it is gratifying to know that the proposals have now advanced beyond the stage of discussion, and that measures are shortly to be taken to carry the various schemes into execution. Government has sanctioned the execution of all works required at stations to allow of the maximum number of trains being worked through.

**THE "SALT" RING.**—An English correspondent says that Cheshire salt has lately been selling at unremunerative prices. But a ring has now been formed, a monopoly is being established, and fancy prices will soon be established. The correspondent suggests that India, as a yearly consumer of some 400,000 tons of the "promoted" article, will suffer therefore. That is possible only. English salt is a luxury only indulged in by the rich, and so intrinsically cheap (for their pockets) that a rise in price will not make itself appreciably felt. All the same, could not something be done to improve the manufacture of Indian salt, and so to dish greedy monopolists?

**ECONOMY?**—The Government of India are supposed to be in an impecunious state judging by their action in regard to the Staff of the P. W. Department and to the stoppage of increments due to officers of the open line



**N.-W. Railway.** Yet in order to please a private firm competing for their orders they ordered an engine and train of some twelve vehicles from the Eastern Bengal Railway to the western frontier of Beluchistan and back to Calcutta, in order to make some half dozen experiments with Vacuum brakes. More than one engine and fully as many vehicles belonging to the Sind section N.-W. Railway have for some time past been fitted with the same brake!!

**THE DEFENCES OF SINGAPORE.**—The War Department has been unable to furnish the remaining portion of the armament for Singapore, owing to the heavy guns supplied by the manufacturers for the Forts not having stood the severe tests. The latter, however, has had its misfortunes, and time will tell what may be in store for the former now required. Some months more will, therefore, elapse before those guns are received in the Colony. The quick-firing guns will be despatched from England in November, or perhaps earlier. Three out of the seven Forts have been completed and armed and are ready to be handed over to the Military authorities.

**A RUSSIAN RAILWAY BRIDGE.**—We glean from a home paper that a bridge, by which the Transcaspian Railway will cross the Oxus at Charjui, was constructed simply for the transport of material by Mr. Balensky, the Engineer concerned, but the Railway directors have determined to use it for trains; and it is estimated that it will last about ten years, after which it will be replaced by a more permanent structure. The total length from bank to bank is 12,817 feet 8 inches; but the river is broken up into one main and three subsidiary channels at this point, and intervening islands will be utilised for supports. The rails are only between 5 feet or 6 feet above the level of the river during floods.

**MYSORE RAILWAY.**—Up to 1885-86, the year before which the Mysore Railways were transferred to the Southern Maharatta Company, the capital outlay was Rs. 64,89,346. The income in the year was Rs. 15,18,212. The cost of working Rs. 8,88,026. The net earnings Rs. 6,30,186. Outstandings and demand payable at the end of the year Rs. 18,088. The net receipts Rs. 6,48,274. The interest on capital Rs. 11,31,765 and the net deficit Rs. 4,83,491. During the same year there were 3,135 first-class passengers; 13,674 second-class ditto; 4,31,788 third-class ditto; who paid approximately Rs. 2,64,484. The total from passengers and traffic was Rs. 4,33,954, and the working expenses Rs. 2,26,170.

**CLIMATE OF THE BRITISH EMPIRE.**—*Symons's Meteorological Magazine* for August contains an interesting summary of the climate of the British Empire during 1887. Comparing with the summary for 1886, Stanley, Falkland Isles, takes the place of London as the dampest station. Adelaide has the highest shade temperature, 111°·2; the highest temperature in the sun, 164°; and is the driest station. Winnipeg has the lowest shade temperature 42°·7 and the greatest yearly range, 135°·9. Bombay has the greatest rainfall, and Malta the least, and also the least cloud. Although the maximum shade temperatures in Australia exceed those in India, the average maxima of the latter far exceed those of Australia.

**STORAGE OF EXPLOSIVES.**—If nitro-compounds are to be safely stored at Aden, a correspondent contends that a magazine must be built in the sea itself, so that

the cases containing the explosive will remain always several feet beneath the sea level at low tide, and, consequently, be always fairly cool. Such a magazine could easily be erected, and, though somewhat novel in design, is the only way in which perfect safety can be secured in a climate like Aden. Those explosives that are not permanently injured by water, might be stored in wooden boxes, and the remainder might be packed first in gutta-percha or ebonite cases inside the wood. Zinc should be avoided as tending to set up electrical action when exposed to salt water for any length of time.

**MORE RAILWAY ACCIDENTS.**—Asansol has been obtaining an unenviable reputation for disasters arising in connection with the working of that important station on the E. I. R. Of course, it is not in the interests of the Railway authorities to give publicity to disasters of this kind, and we have only accidentally heard of one of these occurrences of recent date, which involves interesting issues between the Loco. and Traffic branches without reference to the cost to the State. The facts are that while the yard pilot was shunting across the up-line between the distant and main signals she was run into by a "goods" (1,000) ton-train, completely wrecking five waggons of the former and seriously damaging the two engines of the latter. No lives were happily lost, but if instead of a "goods" it had been a "passenger" the consequences may be better imagined than could be described.

**THE DECCAN COAL-FIELD.**—A correspondent of the *Pioneer* says:—"There is no doubt of the goodness of Singareni coal at a price. It is like good Raniganj, such as sells in Calcutta at Rs. 10 a ton. It is not as good as Kurhumbali in appearance, though it is said to keep steam well in locomotives. Nor is it as good as Burrakur egg-coal. The Assam coal it does not resemble in the least either in appearance or duty." Raniganj coal selling at Rs. 10 a ton in Calcutta will be news to coal owners in Bengal. The same correspondent adds:—"There is manifestly a fine future before what is known as Singareni coal, but the concern needs nourishment and careful nursing. The coal must be generously introduced to the markets waiting for it in plentiful quantities and at reasonable prices \* \* \* the whole question of the development of Singareni begins and ends in labor. But good labor premises good management and generous finance."

**RAILWAYS IN QUEENSLAND.**—The report of the Commissioner for Railways in Queensland for the year ended 31st December last has been issued, and it shews that the total expenditure on the Railway lines of the Colony up to that date amounted to £12,482,576, of which £1,162,192 was for lines still under construction or survey at the end of the year. The interest amounted to £524,807 per annum, and the average cost of the lines opened for traffic was £6,414 per mile. The gross earnings for the year shewed an increase of £85,217, or about 12½ per cent. over those of the previous year. The interest contributed by net earnings from all lines in 1887 amounted to £243,533, and the interest on the total capital expenditure on all lines was 1·95 per cent., the interest on lines opened for traffic and bearing revenue being 2·15 per cent. The construction of the first section of the Railway from Normanton to Cloncurry has been authorised.

**THE POONA EXHIBITION.**—Captious critics have objected to the Poona Exhibition that it contains only such



a collection of goods as may be seen displayed at the doors of Indian Hotels, and in so-called curiosity shops. Defenders of the show ask them—how about the steam engine, and the slate cutting machine, and the scientific instruments manufactured by native artisans at Kolhapore? How about the excellent paper turned out from the Reay Mills at Bombay? How about the Baroda glassware? How about the locks, knives, clocks, woodwork, and pottery from various parts of India? The captious critics have the worst of it, we take it. The Poona Exhibition, in a quiet unassuming way, seems to be doing good work, and has managed to gather together interesting specimens of manufactures that are new to the hands of Indian workmen as well as specimens of the arts to which they are habituated. The Exhibition denotes progress; is a signpost on the way to further progress.

**BOMBAY PORT TRUST.**—The Acting Engineer for Dock Construction, has submitted modified plans and estimates for graving dock in accordance with Trustees' Resolution of 29th June 1888. The modifications are:—The length reduced to 500 feet when caisson is at inner berth, actual floor of dock 62 feet; upper altars 2 feet instead of 1 foot 6 inches; side timber slides are done away with; the altars are carried round the ends and steps, and a timber slide provided at the end; the floor slopes from head to stern. He proposes to remove three bays of a shed to make room for engine and pumps and re-erect them as an addition to another shed, and to use pumps of less power than at first proposed, but sufficient to empty the dock in  $3\frac{1}{2}$  to  $4\frac{1}{2}$  hours. He suggests that the entrance be altered in dimensions and shape to suit, for the outer berth, the caisson of the communication passage. Attached to the estimate is a statement showing the cost of the present as compared with the former design, the total of the present one being Rs. 12,75,105.

**SIR JOHN FOWLER ON THE MALIGAKANDA RESERVOIR.**—It appears that the Colonial Office called in Sir John Fowler, to advise them as to what was best to be done with the broken reservoir, and after careful consideration, he made his report. He does not support the finding of the local Commission that the failure was due to the defective foundations, but agrees with Mr. Burnett, that the cause is traceable to expansion and contraction of the walls exposed to a tropical sun. Sir John Fowler says that he is "of opinion that the resisting power of the walls against the pressure of water has been frequently diminished by two-thirds and even less of their normal strength." Sir John Fowler regrets that he cannot recommend a less costly mode of repairing the tank, which he estimates at Rs. 1,40,000! This amount is one-quarter the cost of the reservoir in the first instance. Mr. Burnett's services are to be retained, and he is now said to be on his way out to carry out the repairs of the work on the lines laid down by Sir John Fowler.

**THE NORTH-WESTERN RAILWAY.**—The *Civil and Military Gazette* writes:—The Departmental reductions and changes on the North-Western Railway, arising out of the amalgamation of offices, have been completed in some Departments. In others some yet remain to be carried out. It is stated that some offices at any rate will be reduced by one-third of their present strength, which—if a real economy and not a sacrifice of working power—would mean a great deal. Of course under the new system district officials will have considerably extended districts and correspondingly enlarged responsibilities. We doubt, however, whether the new

*régime* will be found too workable, and whether the "fusion" now going on should not be more completely spelt "confusion." The full changes contemplated and decreed by Colonel Conway-Gordon and his parting gift to the much-tinkered North-Western Railway will not of course be complete, until the line some months hence is handed over for working entirely to R. E's.

**THE RE-SURVEY OF THE STRAITS SETTLEMENTS.**—Colonel Sir Charles Wilson, Director of the Ordnance Survey, has come to the conclusion that the Colony stands in sore need of re-survey, district by district, to be taken in hand at the earliest opportunity, with discretion in turning the materials of the existing surveys to account for the purpose. In his opinion, it would be well to ask the Indian Government to undertake the re-survey. He has no doubt of a satisfactory result when the undertaking is unreservedly put into the hands of the Indian Survey Department. On Colonel Barron's estimate of the expenditure required for the Survey, at \$403,568, he pronounces no opinion save confidence that it has been carefully made. Colonel Wilson concludes by recommending survey by the Indian Survey Department, as the best and most economical course in the interest of the Colony. Lord Knutsford approves of Colonel Wilson's views, and deems that the question of separating the survey from the Public Works Department should stand over for the present.

**AN ORIGINAL PROPOSAL.**—At the July meeting of the East India Association, a paper was read by Pundit Sree Lal (late Secretary of the Bijnor Agricultural Society) on agricultural improvement in India. His notion is to have Agricultural Societies all over the country, and in connection with each Society an Engineer whose duty it would be to prospect his district and project "the various irrigation works required." But how if irrigation works were not required—if carrying away water instead of storing it up for future consumption and enrichment of the soil commended itself to judgment and experience? Would the East India Association affiliated Baboos be inclined to listen to reason in such case? We fear that they would not. We fear that having made up their minds to a flood, they would be satisfied with nothing less. Pundit Sree Lal's crowning argument in favor of his proposal is that by virtue of it "the existing Public Works establishment in each province could be considerably reduced." It is a pretty enough argument—for people who would like to see India relapsing into the condition of jungledom under which it was suffocated in the latter days of the Mogul Empire.

**INTERNATIONAL TRAMWAY CONGRESS.**—The International Tramway Congress is now holding an annual session in Brussels. The other countries represented at the Congress are England, Austria-Hungary, Denmark, Spain, France, Greece, Italy, Holland, the Philippine Islands, Norway, Russia, Sweden, and Switzerland. The International Tramway Union numbers now as ordinary members 97 companies and 86 personal members; and as extraordinary members 43 firms and 51 personal members. Of the countries represented in it Germany comes first, with 114 adherents, and Belgium next, with 66. The numerous questions under discussion relate to the provident institutions for the tramway officials in which the companies co-operate; the rations of horses and their average daily work and the time in which it is performed; the systems and composition of wheels and axles the power of resistance of tramway cars; the system of



rails and of brakes; and the composition, *personnel*, and ticket system for trams, their normal speed, and the average distance between stations. The Congress will make some interesting excursions. Several English Engineers are at the Congress.

**THE BOMBAY P. W. D.**—The *Times of India* commenting on the recent Resolution says:—"The scheme for the re-organization of the Public Works Department has at last been made public, and simultaneously the apology which now accompanies all Government notifications has appeared. By these apologies public opinion is not in the least influenced, but the reputation of the Bombay Government suffers grave injury from the inaccurate statements put forward by those who seek to serve it, not wisely, but too well." Thus after eighteen months the problem has been solved. Who is to be Secretary to Government in the Public Works Department? And it is open to grave doubt whether it was worth while to create grave discontent throughout a whole department to make the change. The scheme is condemned by professional men as entirely unpractical. Time will shew whether any real good will be wrought by it. It would have been wiser to have submitted the scheme to public and professional opinion before launching it into the world. But, unfortunately in India, criticism has to follow instead of preceding a grave and important action like the re-organization of one of the most important departments of the State.

**BURMA RAILWAY.**—The annual accounts for the year 1887-88 of the Burma State Railway are now under submission to the Secretary of State for India in Council. This is an interesting little Blue book shewing a statement of capital sanctioned and provided by Government to the end of the year 1888-89. From it we gather the following particulars. The construction cost involving actual and direct outlay up to March, is £268,756. This sum is made up by the expenditure heads, Establishment £203,208, Plant £66,300, Rolling Stock £361,265, Loss by Exchange £125,061, Suspense £74,194, Works on sections open for traffic £2,038,728. The Estimates for both sections having been closed, the sanctioned cost is taken as under for the last three years:—

Outlay to 31st March '87.	£2,868,756
do during 1887-88	„ 22,700
do Grant for 1888-89	„ 37,625
	£2,929,081

At present the unutilized portion of the grant lapses at the close of each year. The sums, therefore, that are entered as the grants for the several years are also the amounts drawn in those years.

**GREAT WESTERN OF INDIA RAILWAY SURVEY.**—Mr. Horace Bell, the Chief Engineer of the Rajputana Survey, will divide his staff in two parties, he himself working with one from Hyderabad, Sind, the other from Delhi. Two routes certainly and, if practicable during the present season, three routes, will be surveyed. One from, Hyderabad, by Umankote and Barmer to Pachpadra, to join the terminus there of the Jodhpore State line. A second from Hyderabad, *via* Jeysulmere, Bikaner, Bhawani and Rohtak to Delhi, with a branch from Bikaner to Bhawalpore, and another branch from Hyderabad to Rori—this being the route recommended by the projectors of the Great Western of India Railway, of whose representations the present survey is an outcome. And, time permitting, a third route, which will break off at Barmer and run *via* Nagour, through a point north of

Ulwur to Aligarh, where it will strike the junction there of the Oudh and Rohikund and East India Railway systems; with a branch almost due north from Hodal to Delhi. This last-named is understood to be the route of Sir Bradford Leslie's later adoption. If this survey is carried out with anything like the completeness sketched above, the deserts of Rajputana will cease to be the favorite battle-ground of rival promoters.

India the saving in freight both on raw cotton and manufactured goods is an item that must also be considered in the rivalry. From every point of view in fact England is at a disadvantage. Let her make haste to secure the Chinese market, lest India try a fall with her there too.

The only other matter in the *Statist* before me likely to interest readers of *INDIAN ENGINEERING* is a review of the condition of the iron and metal trades between 1886 and 1887, and we are told that at the beginning of the year under review a stimulus was given to the iron and steel markets, in consequence of receipt from the United States of large orders, due to the activity of railroad construction there at the time referred to.

Between the 1st July 1886 and the end of 1887 some 20,000 miles of iron road were laid down; and at first almost all the metal material for it was requisitioned from England. But soon the local demand induced a local supply, with result that whereas in 1877 the United States produced 2,100,000 tons pig iron in contrast with 6,60,000 tons of Great Britain's, in 1887 the United States total of production was 6,250,000 tons—a huge stride on the way to equality. But it is written that "the pace at which railroad construction was going on in the United States was too fast to last, and, in consequence of the apprehensions of monetary stringency in the autumn," capitalists were found unwilling to further encourage venture on the part of some companies in their ambition for extensions.

As a result orders for material began to fall off everywhere, alike in the new world and in the old, and the price of metal gradually declined, and continued to decline if a very temporary spurt towards the end of the year is left out of the account—as it ought be. It was due to a fresh impetus given to business by the extension of shipbuilding. Only the brokers and the traders who occasioned the rise quite overlooked the fact that use of iron in the construction of ships has almost gone out of fashion. Steel is the material now. It is estimated that fully 80 per cent. of the new ships built in 1887, or building at the end of that year are of steel.

Production of iron in Enland has, we are told, been kept down by agreements among the ironmasters in both the Scotch and Cleveland districts. It is nevertheless asserted that stocks of iron have been added to during the year under review.

We are also informed that the danger to the metal markets the prices in which have moved so violently.

**THE NORTH-WESTERN RAILWAY.**—It has already been notified that a re-organization of the Administration of the North-Western Railway had been determined on; and that orders have now been issued for carrying it into effect. Hitherto the Railway has been worked in two sections, *viz.*, the Punjab Section, about 1,600 miles long, with head-quarters at Lahore, and the Sind Section, 900 miles long, with head-quarters at Sukkur. Each section was in charge of a Manager, under whom were the Heads of the Engineering, Traffic, Locomotive, Accounts, and Stores Departments. The Managers were responsible to the Director for the working of their sections, and thus the control of the whole system was vested in the Director, while the *working* of the sections was confided to the Managers. This system had been in force since April 1887. Government has now determined to abolish the two sections system and to centralise the working of the whole line at Lahore. On the arrival of the Sukkur Offices here, about the 25th instant, the establishment of the new organization will be carried out. The control and working of the whole line will then be vested in the Directors, supported by two Deputy Managers; and the various Departments will be placed under the following officers:—

Traffic	...	...	Mr. R. M. Rutherford.
Engineering	...	...	„ F. R. Upcott.
Locomotive	...	...	„ C. Sandiford.
Accounts	...	...	„ R. K. Williams.
Stores	...	...	„ Cunliffe.



## Current News.

It is contemplated to open a Silk and Cotton Mill in Poona City.

COLONEL MALLOCK, Director-General of Telegraphs, has started on his tour of inspection in Persia.

LIEUTENANT W. HUSKISSON, R.E., has been struck off the Indian establishment on reversion to Imperial duty.

ware? How about the locks, knives, clocks, woodwork and pottery from various parts of India? The captious critics have the worst of it, we take it. The Poona Exhibition, in a quiet unassuming way, seems to be doing good work, and has managed to gather together interesting specimens of manufactures that are new to the hands of Indian workmen as well as specimens of the arts to which they are habituated. The Exhibition denotes progress; is a signpost on the way to further progress.

**BOMBAY PORT TRUST.**—The Acting Engineer for Dock Construction, has submitted modified plans and estimates for graving dock in accordance with Trustees' Resolution of 29th June 1888. The modifications are:—The length reduced to 500 feet when caisson is at inner berth, actual floor of dock 62 feet; upper altars 2 feet instead of 1 foot 6 inches; side timber slides are done away with; the altars are carried round the ends and steps, and a timber slide provided at the end; the floor slopes from head to stern. He proposes to remove three bays of a shed to make room for engine and pumps and re-erect them as an addition to another shed, and to use pumps of less power than at first proposed, but sufficient to empty the dock in  $3\frac{1}{2}$  to  $4\frac{1}{2}$  hours. He suggests that the entrance be altered in dimensions and shape to suit, for the outer berth, the caisson of the communication passage. Attached to the estimate is a statement showing the cost of the present as compared with the former design, the total of the present one being Rs. 12,75,105.

**THE MALIGAKANDA RESERVOIR** extensively repaired. about forty acres, at an elevation surrounding country.

MR. RYLES, the Locomotive Superintendent of the O. and R. Railway, has been offered the post of the Bengal and North-Western Line which was rendered vacant by the death of Mr. Rhind some weeks since.

LORD CONNEMARA holds out no hope of State assistance to the proposed Railway from the West Coast to Mysore, Tellicherry, and Cannanore, which is as good as saying that unless the work is undertaken privately it will never be done.

THE revised estimates of land revenue of Mysore give nearly four lakhs more than the aggregate of the estimates of 1887-88, and in excess of any previous year. The Sirkar intends, it is believed, to expend the greater part of the surplus which is now looked for on irrigation works.

THE term for which the services of Mr. T. W. Hughes Hughes, Superintendent Geological Survey of India, had been lent to the Hyderabad (Deccan) Mining Company having expired on the 1st instant, Mr. Hughes has been ordered to proceed at once to Burma, to superintend the working of the Ruby Mines.

THE official programme of tour of the Director-General of Railways, and Sir Charles Elliot, the Honorable Member of Public Works Department, has been changed, and these officers will now leave Simla on the 26th and 27th instant, and proceed thence by rail on the latter date to Delhi, and after completing their journey over the R. M. Railway, they will arrive at Ferozepore on the 30th instant.

LIEUTENANTS TRAVERS and Henning, Royal Engineers, are employed on survey duties, in connection with the defence work on the Raja Hoti range of hills. This range of hills overlooks the Railway bridge at Attock, and also commands the Railway and River Indus for a considerable distance. The work of levelling sites for bungalows, making roads, &c., was in course of construction during the cold weather, but had to be suspended during the summer months; it is expected that the work will be re-commenced about the 15th November.

## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*

### RAILWAY AND "RED TAPE."

SIR,—Your article on the above in your issue of 6th October 1888.

If you will look at the Civil Accounts Code, 1886, page 20, you will find the Certificate referred to laid down by the Financial Department, for general adoption in all Departments of Government. The Railway Department, as all other Government Departments, is in the hands of the Financial Department, and has only to do what it is told.

Your article is wrong in one point. Managers of lines are not required now to sign or rather countersign Contingent Bills! They were relieved of that a short time ago.

Having gibbeted us, you might now put the saddle on the right horse.

P. W. ACCOUNTS.

SIMLA; October 16, 1888.

### WELL VS. CANAL WATER FOR IRRIGATION.

SIR,—No wonder "E. A. S." is surprised to hear that "well water has once more proved itself superior to canal water for irrigation," for it is only so in appearance. The mild Hindu makes it so no doubt as he over-irrigates with canal water owing to getting it by gravitation and therefore without any great effort. He merely turns the tap on and takes, as he thinks, as much value as possible for his money. In the west of Khandesh, and elsewhere, where the water-supply in the canals is not over-abundant, and where its distribution is under the jealous supervision of the villagers themselves, each man gets by rotation barely enough for his crops; and though 12 years in charge of that district I never heard of the superiority of well water to that taken from canals. At the same time I had charge of several canals, the management and distribution of water in which was in the hands of canal officials. On these, the cultivators went in for the full-value-for-your-money principle with no success, and much abuse of the unskillfully used element.

P. R.

October 16, 1888.

### THE TOUNGOO-MANDALAY EXTENSION.

SIR,—The section of the above line recently opened for traffic is a poor result from the so-called rapid progress in constructing the line and opening throughout for passenger traffic from the 1st of present month, as was confidently predicted, and even officially notified last April or May. From Thawattu to Pyinmana is only about 32 miles by the sketch of the line, and at this rate of progress it will be a long time before passengers are conveyed through from Rangoon to Mandalay. Indeed, it is feared, it will be a considerable time before even Yemethen is reached, but if this point was passed, it is believed the next 54 miles (the whole 5th Division) would present no obstacle to through goods traffic and passenger traffic. The 6th Division, especially the section between Myitha and Thabyadoun, will be no trifle, as it is believed portions of the earthwork have been washed away in consequence of insufficient waterway having been provided therein. This section was peculiarly liable to inundation and overtopping from the floods off the Shan hills and the very scant waterway provided; indeed, a channel of no mean dimensions was closed up entirely in this length, with what results must long ere this have been manifest.

DELTA.

### BENGAL COAL COMPANY, LIMITED.

SIR,—I must concur with the remarks made by your correspondent "Enterprise" in his letter to you of the 13th instant.

This frequent change of management in a large Coal Company is greatly to be deprecated, and I am one of those who has large interests in these concerns, and have noticed that the Companies who have the least changes are the most flourishing—e.g., the "Burrakur," the "New Beerbhoom," &c.

In the case of the Bengal Coal Company we have a Manager who has for the last three years shewn us a good dividend sheet, and now we are informed that he is going, and his place is to be taken by a raw hand, one of his own assistants, on a smaller pay, and with only 3 years' knowledge of the country—in one particular locality. This arrangement will speak for itself, as time will shew.

I was one of those who supported the proposal to obtain the services of Mr. L. J. Whitty, M. Inst. C. E., F.G.S., by inducing him to leave a high professional post under Government to join us.



Were it not for the opposing currents in the internal economy of our Directorate, the *disseverance* to which "Enterprise" refers would not have occurred.

I contend, and other shareholders agree with me, that the General Management of the "Premier" Coal Company of India and of the Far East should only be entrusted to one capable of maintaining the position by professional knowledge, status, and other considerations.

CALCUTTA; October 22, 1888.

SHAREHOLDER.

[We are disposed to endorse the views of our Correspondents "Enterprise" and "Shareholder," from the fact that the Articles of Association of the Bengal Coal Company, Limited, embody considerations which no professional gentleman with a reputation to maintain could be expected to accede to or work under.—ED., I. E.]

#### MOORE'S IMPROVED CAST-IRON SLEEPER.

SIR,—With reference to another "Railroader's" letter in your issue of 13th October last, I should like to make a few remarks.

As regards the D. and O. sleeper, I quite agree with him that it is bad packing that breaks the plates. If perfect packing could be ensured it would not be difficult to design an unbreakable sleeper. To ensure good packing I have always advocated inspection holes in plate or pot sleepers as the only way that inspectors can test the packing, and by the insertion of a bar see whether the work has been properly done.

He finds fault with my design as being sure to break under the rail, but he gives no reason why he should think so. I do not myself anticipate any difficulty on this point, nor as regards the other point he mentions, namely, the rail being kept against the outer jaw by the tie bar being cotted up to it, but experience can only authoritatively decide these points.

He says that I appear to be of an opinion that the D. and O. sleeper breaks across the centre in consequence of the leverage due to the rail being at so great a distance from the bottom of the sleeper, and that in his opinion breakages of that class are due to the plates not being properly packed. I quite allow that given no flaw in the casting and perfect packing no plate would break, but at the same time given a flaw or imperfect packing the leverage due to the height of rail above the plate must help towards the destruction of the sleeper. In my design the rail is placed directly on the plate, and instead of the centre ribs above, I have side ribs below, which besides strength give the plate a better hold in the ballast, minimising the rocking of the plates which must be the more felt the higher the rail is above the plate. It is this rocking motion which necessitates the frequent repacking of plate sleepers.

G. E. M.

October 20, 1888.

#### INDIA VERSUS ENGLAND.

SIR,—It should warm Anglo-Indian and Indian mercantile hearts to find the London *Statist* sounding a note of warning to whomsoever it may concern amongst the British public on the subject of Indian cotton manufactures, and India's yearly increasing trade in cotton stuffs. The competition of India with Lancashire is growing "really alarming" says the outraged English organ, aghast at the thought that English piece-goods monopolies have seen their best days, and are being ostracized from the markets of the much enduring Hindoo, who is being educated up to appreciation of the fact that a genuine article is cheaper and more delectable than sized and otherwise "salted" stuffs.

During the last decade or so mills have multiplied, and development of Indian production has been going on at a very rapid pace: e.g., in 1876 Bombay had 47 mills, with about 1,000,000 spindles and 9,000 looms. Ten years afterwards the number of mills had exactly doubled, the figure standing at 94, while the number of spindles had more than doubled, being 2,261,000, and there was a similar increase in the number of looms. With reference to its export trade, India in 1876 exported less than 8 million lbs. of yarn. In 1886-87 she was able to ship nearly 92 million lbs. Piece-goods were shipped from India in 1876 to the beggarly tune of 15½ million yards. In 1886-87 nearly 53½ million yards were carried away from her shores. Summed up in another way the total value of yarns and piece-goods exported from India in 1876 was less than three-quarters of a million sterling. Ten years afterwards the value of these said exports had mounted up to about four-and-a-half millions sterling. *Sic itur ad astra.* Let us hope that they will continue to mount up. Barring reduction of the Home Charges 'tis the only wholesale way in which we can hope to obtain compensation for the depreciations of a rupee that appears to have lost all sense of self-respect, and is incorrigibly abandoned to drunken staggers, and fallings down in the market place. Every dog should have his day the theologians affirm; and Lancashire has had a monopoly of the trade in yarns and cotton stuffs long enough.

Let her exploit China now, or if she wants other happy hunting grounds let her assist in opening the Railway between Assam and Burma.

India in turn will exploit Manchester and its suburbs, London, Glasgow, Nottingham, and the Southern counties. It is edifying to reflect that Lancashire cannot in the nature of things economical compete successfully with India, as long as India has the advantage of cheap, suitable, and abundant land, and a super-abundance of cheap labor. As to the piece-goods market in India the saving in freight both on raw cotton and manufactured goods is an item that must also be considered in the rivalry. From every point of view in fact England is at a disadvantage. Let her make haste to secure the Chinese market, lest India try a fall with her there too.

The only other matter in the *Statist* before me likely to interest readers of *INDIAN ENGINEERING* is a review of the condition of the iron and metal trades between 1886 and 1887, and we are told that at the beginning of the year under review a stimulus was given to the iron and steel markets, in consequence of receipt from the United States of large orders, due to the activity of railroad construction there at the time referred to.

Between the 1st July 1886 and the end of 1887 some 20,000 miles of iron road were laid down; and at first almost all the metal material for it was requisitioned from England. But soon the local demand induced a local supply, with result that whereas in 1877 the United States produced 2,100,000 tons pig iron in contrast with 6,600,000 tons of Great Britain's, in 1887 the United States total of production was 6,250,000 tons—a huge stride on the way to equality. But it is written that "the pace at which railroad construction was going on in the United States was too fast to last, and, in consequence of the apprehensions of monetary stringency in the autumn," capitalists were found unwilling to further encourage venture on the part of some companies in their ambition for extensions.

As a result orders for material began to fall off everywhere, alike in the new world and in the old, and the price of metal gradually declined, and continued to decline if a very temporary spurt towards the end of the year is left out of the account—as it ought to be. It was due to a fresh impetus given to business by the extension of shipbuilding. Only the brokers and the traders who occasioned the rise quite overlooked the fact that use of iron in the construction of ships has almost gone out of fashion. Steel is the material now. It is estimated that fully 80 per cent. of the new ships built in 1887, or building at the end of that year are of steel.

Production of iron in England has, we are told, been kept down by agreements among the ironmasters in both the Scotch and Cleveland districts. It is nevertheless asserted that stocks of iron have been added to during the year under review.

We are also informed that the danger to the metal markets, the prices in which have moved so violently, is that a great deal of the speculation is on account of persons who have no legitimate business whatever in the markets which they have operated in. If a consumer foresees the probability of the statistical position leading to an advance in prices, and provides himself against future contingencies by laying in stock, and by so doing causes a rise, such a movement would be neither violent nor fictitious; but if a capitalist, having money loose for a short time, enters into transactions on the idea of securing a snap profit by selling at a higher price than he has bought at, the market becomes altogether disorganised, and the legitimate trader does not know how to act.

When will Indian iron and copper become of sufficient importance to be deemed worth notice by the *Statist*?

FAIR TRADE.

#### THE INDIAN ARCHÆOLOGICAL SURVEY.

SIR,—Referring to your remarks on Mr. Rea's Report, I must say that some of his suggestions fairly astound me. He tells us that except a few fragments of bases of pillars (any Architect who had once seen Indian pillars would call them fragments of square shafts, for no Indian or any other known pillar base, properly so called, can be 15 inches square and 3 feet long) and pedestals, and a brick "swastika," and the chipped fragment of an unreadable inscription, nothing has been found in a certain locality; and as for its being a stupa at all, I see from the drawing that the dome is purely imaginary: yet to secure such a trumpety find, the Government is to resume the land! If every such imaginary stupa in India were to be resumed by Government, we should soon find ourselves within measurable distance of a rebellion. I deprecate, in the strongest terms I can, the adoption of any such insane policy; and consider that the Archæological Survey of India has been instituted, not to create disaffection and rebellion in the country, but politically, and apart from its scientific aspects, rather to shew the people that Government takes an intelligent and benevolent interest in the past glory of the country; and the judicious working of the department, I conceive, ought, among other results, to achieve this one result also. Resume possession! Where, I ask, is the process of resumption to stop if the principle be once admitted?

But enough of politics which is not my forte; we are asked to



believe in a purely imaginary dome, inclosing apparently a hollow space, with a swastika in the centre; and we are further told that this dome, 3 feet thick, would have straightway, when built, tumbled down on the introduction of moisture, and in some unexplained and wholly inconceivable manner, break the surrounding marble railing in such a way as to cause "some small bits of marble" to adhere to the old, dry, plastered surface of the parapet wall, fully 13 feet 6 inches off, on the inner side of (or within) the railing! We are further treated with a flourish of trumpets to a small disquisition on Buddhist symbolism in general, and the remarkable discovery made by Mr. Rea in particular that swastikas being Buddhist symbols, a stupa not inshrining relics, might obtain the requisite sanctity, by inshrining an inaccessible swastika or a trisul or a chakra or some other symbol! I have a very vivid recollection of the chakra, the trisul, and the swastika, being Hindu symbols as well as Buddhist: may not therefore a Hindu or a Greek temple be found, which, inshrining not a statue, but a trisul (Neptune's trident) might consequently have become an object of worship to Hindus or Greeks? Imagine an Athenian worshipping, not Neptune, but Neptune's trident! or a Hindu worshipping Ramachandra's shield! What a refreshing variation on the usual objects of worship!

It will serve no purpose to go on; enough examples I believe have been given, to shew, that Mr. Rea would do well, when writing a report, which, he must be aware, is accessible to the public, to be more intelligible in his English, and less carried away by his imagination, and a fancied knowledge of the laws of mechanics. Three feet is by no means too little a thickness for a dome 45 feet in span, as any Engineer or Architect would have told him if he had but asked; while as regards his hopeless floundering between piers and pillars and pillar bases; capitals and cornice overs; horseshoe blocks and "ingoing" rocks, inclosing "rooms of two tiers"; to say nothing of such marvels as piers "built in the sills of gopuras" and "in the floors" of mandapas, varied by "domical sikaras," "Arya stambhas," foundations of domes built within the hollow of the dome, "figure pances," &c. I would recommend to him an earnest study of the elementary definitions and meanings of names in Architecture and in Engineering, before he again ventures into technical phraseology in preference to plain English.

The fault here is hardly the fault of Mr. Rea; I hope his drawings are more intelligible and less fanciful than his report: but when Government with such a redundant surplus of capable professional Engineers, as in some provinces raises the cost of establishment to 45 per cent. of the money used in works, persists in filling a department, which avowedly mainly deals with architecture, with non-professional agency, all I can say is, that it deserves to digest this sort of unrecognisable hash, which is every now and again served up for its special delectation, to the amused, and for myself I will say, grieved, wonder, of the world of professional Engineers and Architects. You have before pointed out, and now I again point out, that in the entire staff of the Archaeological Department, except one solitary Engineer officer, not a single Architect or Engineer is to be found; and yet these poor, and I have no doubt hardworked men—all the more hardworked and perplexed, because they are not professional Engineers—are expected to make technical drawings, plans, elevations, sections, &c., of buildings; and to write intelligent reports on Ancient Monuments, that Government in its serene unconsciousness, hopes will somehow be welcomed by the learned world, and be of use to professional Engineers and Architects.

The Director-General of the Survey, doubtless a very learned scholar, formerly the editor of an antiquarian journal, and now the happy possessor of the unique privilege of spending the hot weather in Edinburgh, but so far as I am aware wholly innocent of any claim to speak with authority on questions of Architecture or Engineering, passes on a report which, as you have shown, is mainly unintelligible, not to the Public Works Secretary of the Government, who might have laid his finger on the weak points (and they are numerous enough) of the report, but to the Chief Secretary, an officer presumably competent in law, in administrative ability and home politics, but equally, if not more, innocent of any pretensions as Engineer or Architect! This system I believe holds even with the Government of India, where the various Government Archaeological resolutions are signed by the Revenue Secretary, the courteous and well known Sir Edward Buck, but who, among his numerous accomplishments, has not, herein differing from Sir Theodore Hope, advanced any claims to being an expert in Architecture or Engineering.

I hold, and all Engineers and Architects will, I believe, agree with me, that the Archaeological Reports, which mainly concern Monumental Archaeology, can properly be dealt with only by the Public Works Secretaries who are Engineer officers, and that a department whose main work is the illustration and the preservation, whether on paper or *in situ*, of monuments, ought to be amalgamated with, and form but one branch of the great building department of the Government—the Department Public Works.

Economy, together with increased efficiency, will thus alone be secured, while incidentally it will relieve the pressure on the Government of having to pay Engineers for whom enough work cannot be found, and the pressure on the Engineers themselves who find promotion blocked.

## IRRIGATION IN THE PUNJAB.

## II.

SIR.—Anyone travelling by rail during the daytime from Lahore to Mooltan cannot fail to be struck with the utter desolation of this tract, especially from Wanvadarum to Mooltan, a distance of 147 miles; and if this most desirable extension—referred to in my last—was carried out, the area for irrigation in the original estimate mentioned would probably be considerably exceeded. The Railway is there already, the soil is good and was once highly cultivated, as manifested by the numerous village sites and high banks of ancient canals existing in this tract. The latter are easily seen from Railway carriage.

At the point where the present canal tail escape discharges into the Ravi river, the latter forms a loop towards the East, which would apparently be a very favorable site for a feeder canal, so as to obtain a supply of water to irrigate this now dreary, cheerless waste. Even an inundation canal taken out from this point would be an immense boon, especially to the small civil station of Montgomery.

It is earnestly to be hoped that this urgently required work will be carried out at an early date. Then, and not till then, will the original project prepared by the greatest Canal Engineer the Punjab ever boasted (the late Colonel J. H. Dyas, R.E.) have a fair chance of realizing the high expectations entertained by that gifted officer, and his illustrious chief, Lord Napier of Magdala.

*The Swat River Canal.*—This canal is probably more of a political than a productive work, nevertheless, the area under irrigation is extending considerably, and it will, in a short time, take its natural position as a reproductive work, similar to the other Provincial canals.

The capital expenditure to the close of 1886-87 amounted to Rs. 33,69,822. The working expenses to Rs. 55,035, and the earnings to Rs. 26,714, being a loss of 0.84 per cent. on the capital expenditure. The canal is still in its infancy, and will, in time, pay its cost, as irrigation is rapidly developing, and the number of villages irrigating has increased from 133 in 1885-86 to 235 in 1886-87. Thus there is every prospect of this becoming probably in ten years a highly remunerative work. The duty per cubic foot of water is exceptionally high on this canal, being 250 acres for the year. The *khurreef* 62, and the *rubbee* 188. This is the highest duty realized so far in the Punjab. Another favorable feature on this canal is, there was no Lift irrigation whatever during 1886-87 on the canal.

The canal being still in its infancy full water rates are not yet charged. Thus had the usual full rates been charged of Rs. 2.8 per acre on the 74,373 acres irrigated, the amount would have been Rs. 1,85,933, instead of the small sum Rs. 25,982, being a difference of Rs. 1,59,951. This light assessment is no doubt good policy in this particular case.

The estimated value of the produce irrigated, and entirely due to irrigation by this canal, amounted in 1885-86 to Rs. 7,01,205, while in 1886-87 the value was Rs. 17,94,558. This is conclusive proof of the rapid extension of irrigation on this canal, and augurs a hopeful future. This great increase is due to the scanty rainfall in this particular district, and is almost the normal condition of it, so that fluctuations will be rare and trifling in quantity and amount.

*Sirhind Canal System.*—This is by far the most splendid system of canals in the Punjab, and 'tis a pity the open mileage is not given as on the Bari Doab and Western Jumna Canals. The capital expenditure on the Sirhind Canal up to the close of the year 1886-87 is as follows:—

From Imperial funds	...	Rs. 2,23,93,907
" Contributions	...	" 1,28,51,884

Total from all sources Rs. 3,52,45,791 \*

The working expenses amounted to Rs. 3,44,951, the earnings were, from water rates Rs. 3,22,001 and from miscellaneous sources Rs. 43,111, or in all Rs. 3,65,112. This system of canals is also in its infancy, as full water-rates do not appear to have been levied. Thus 215,625 acres at the full rate of Rs. 2.8 per acre would have produced

...	Rs. 5,39,063
-----	--------------

Instead of the small sum ... Rs. 3,22,001

Being a difference of ... Rs. 2,17,062

The canal was opened in 1883-84 with a beginning of 5,030 acres under irrigation, in the next year (1884-85) the irrigated area was 36,102 acres, in 1885-86, 152,837 acres, and in 1886-87, 215,625, so that irrigation is rapidly developing on these canals. The foregoing areas apply to British Territory only, no reliable statistics having been received from the Native States.

During the year, 413 miles of major and 871 miles of minor distributing channels were constructed, leaving only 333 miles of major and 509 miles of minor distributaries to complete the system, which will then contain 1,786 miles of major and 2,091 miles of minor distributing channels. At present, there is no "Lift" irrigation whatever on these canals, which evince the extreme care taken by Generals Crofton and Gulliver and Colonel Robert Home, R.E., in the preparation of this the largest and most important canal project in the Punjab.

\* Interest at 4 per cent. would make the total capital expenditure Rs. 3,66,55,623, which, at the present rate of progress, will be cleared off in 15 to 20 years. Surely this is encouraging.



The height of the head weir at Rupar was increased by 1½ feet, and falling shutters erected on the crest. These additions have greatly increased the control of the river.

The Sirhind system of canals has, therefore, a splendid future.

The rapid development of irrigation on these canals establishes conclusively that had the Bari Doab system of canals and distributaries been carried on as rapidly and continuously as the Sirhind system, the former would have repaid the capital expenditure plus interest charges fully ten years ago, but, as previously stated, India was not permitted to borrow capital for public works, whether remunerative or not, in the days of the B. D. C.

*Sidhna Canal.*—This canal takes out from the Ravi at Serai Sidhoo, near the confluence of the Ravi and Chenab rivers.

The capital expenditure to close of 1886-87 was Rs. 6,74,502.

Working expenses	...	Rs. 14,364
Interest Charges	...	" 25,130

Rs 39,494

The earnings amounted to	...	" 13,193
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Being a loss to close of year of	...	" 26,301
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or 3·89 per cent. on capital.

The area irrigated during the year was 27,162 acres, a very good beginning for this new canal, which is still under construction, while the value of the crops irrigated was estimated at Rs. 7,53,669. Only 37 miles of canal and 112 miles of Rajbhuas were in operation during the year.

There has been no "Lift" irrigation on this canal, and when quite completed it is not likely there will be any whatever.

E. B.

## Literary Notices.

### CALCUTTA HEALTH SOCIETY.

PART II. of Vol. IV. of the Journal of the Health Society lies before us. It is a record of useful work done in an unobtrusive fashion. It contains a kindly letter from Miss Florence Nightingale to the Honorary Secretary which, by a curious coincidence, is dated the 27th July last, the same day on which the Government issued its recent Resolution on Sanitation. The Resolution in question appropriately follows Miss Nightingale's letter, and is supplemented by a valuable note by the Council on the suggestions put forward by Government. Some correspondence which has passed between the Society and the Government of Bengal in reference to the Annual Report reviewed by us in a previous number, and the important subject of the Central Road follows and completes the number. It is clear from the correspondence that the Society is watchful of all those large measures of Sanitation which concern the community as a whole. For ourselves, we do not look for any such stringent bye-laws emanating from the Municipal Committees as will meet the evils of the Calcutta milk-supply. Most of the Commissioners are natives, and as thoroughly imbued with the belief that milch-cows should be kept in the dark as are the *goallas* themselves. Such being the case, it is obviously idle to look to the Commissioners for bye-laws which will compel *goallas* to have their cowsheds properly ventilated and lighted. We quite agree with the Lieutenant-Governor of Bengal that under the New Municipal Act the Commissioners will have complete control over the whole question of the milk-supply; but unless a revolutionary change steals over their dreams, we venture to say that the precise degree of control which is urgently required will not be exercised. The position of the Government in regard to the appropriation of two lakhs of rupees from the savings of the Bridge Tolls to the purposes of the Central Road, is stronger, but it would be a deplorable error to drop the scheme which is the subject of the Society's letter of the 27th June 1888. Can nothing be done to save it? Miss Nightingale's letter is full of encouragement to those in the Society to whom the work of Sanitation has been a much criticised labor of love.

The "Note by the Council" on the Resolution of the Government of India, should serve to bring that Resolution before the public. If so the Health Society will here again have scored as they did in the case of the Municipal Bill. The "Note" is a practical commonsense review of the Government proposals, and should be welcomed by all who have any interest in the policy foreshadowed in the important document of the 27th July last. It indicates where the Resolution fails, and where it will possibly fail. In

the opinion of the Council, the Resolution appears to fail in dealing with financial questions. The "Note" observes that "Sanitary work in any province divides itself into three heads—Temporary, such as may be required to combat an outbreak of cholera, small-pox, fever, or the throwing, from any sudden cause, of particular areas out of cultivation; Local, that is, works intended to benefit special areas by systems of water-supply, drainage, local embankments and the like; General, that is, where large areas and considerable masses of population may be benefited by protective works, whether there be large systems of embankment, drainage or famine roads. As regards the first, experience has shewn that aid to some extent is generally needed from outside. And this perhaps might suggest the formation by local Governments of an Emergency Reserve to be supplied from the Provincial Loan Funds and to which the generous and the charitable might at all times subscribe. The second and third classes of works can scarcely be carried out except by funds raised by loans. And this brings the Council back to the unwisdom, first, of allowing competition in the money market, and, second, of permitting local bodies to pay unduly high rates of interest. The simplest policy is one which would strengthen the hands of the Central Government by concentrating in them all financial operations. The Government of India has a credit uniform throughout the country. It has, too, immense facilities for applying to the English money market, where also its credit gives it opportunities for obtaining money cheaply. Whether the time has come to insist upon localities furnishing means for local works by taxation or loan is more than doubtful. \* \* \* \* \*

"The Health Society, therefore, inclines strongly to the belief that, until visible progress shall have been made and the improvement of general sanitary conditions sensibly appreciated, the only wise policy to be pursued will be that which shall make a provision for sanitary work a recognised portion of the financial contracts between the Central and Provincial Governments and which will reserve to the Government of India the sole right of raising funds for sanitary purposes, and through the local Governments distributing such funds upon carefully settled yet liberal conditions, and as they may be needed. If this be done, then the result must of necessity be beneficial."

As to the possible failure of the scheme sketched in the Government Resolution the "Note" says:—

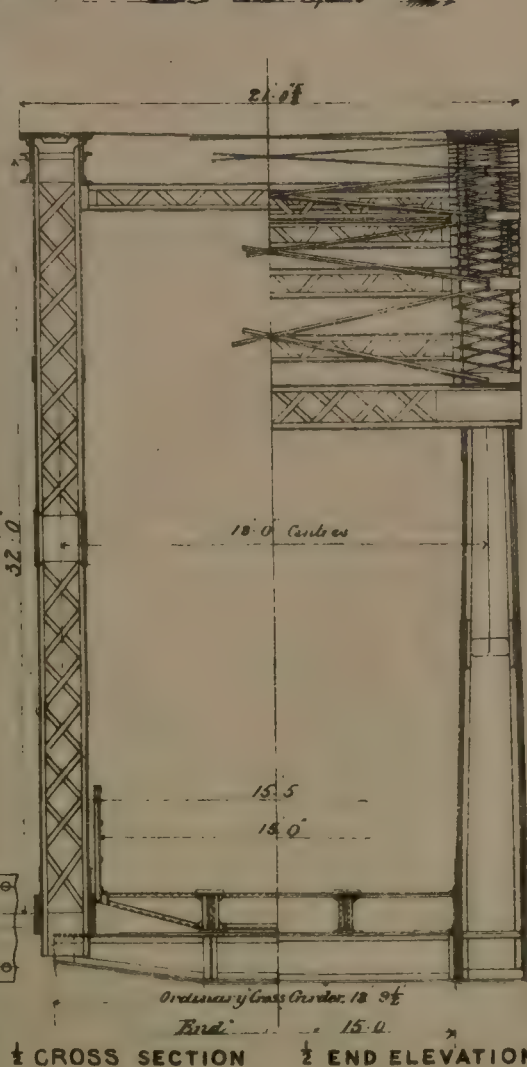
"The Resolution suggests that the Boards might be composed of certain officials, with whom might be associated one or more non-official members. To be of any real use in the way of pushing necessary reforms, the Boards must be constituted on lines very different from those on which the Municipalities are constituted, so as to secure a majority which will, as a rule, be on the side of progress. Next as to the functions of the Boards. These too, are indicated, and with rather more definiteness in the Resolution. They must be the executive agency through which a Government, more enlightened than the bulk of its subjects, is to act in the Sanitary Department. His Excellency speaks very firmly as to what he intends them to be, and unless this intention is fully realized, India, so far as sanitary reform is concerned, will continue in the condition to which Professor Koch has called attention in his Report on the Cholera Commission published lately by the German Government. What is needed is an *executive agency* in the Sanitary Department, that is, *action* of a marked and distinctively progressive character, in lieu of public exhibitions of mere dialectical skill and ingenuity."

All practical men will agree with the Council of the Health Society in considering that if advance is to be made in Sanitation in India, the proposed Boards must be composed of very different material to that found in the various Municipal bodies to which our health and lives are at present entrusted; and work must be done by them in a way very different to that which is adopted by the existing Municipalities. We want more action and less talk, and unless the proposed Boards secure this for us, they may in their issue serve to intensify rather than to remove present evils.









1 CROSS SECTION      2 END ELEVATION







equalities in the ground—and the front wheel made a dig into the soil—or an attempt at a dig—the ground resistance or reaction would be a single force on the bicycle. But the wheel by its  $\beta$ -rotation endeavours to enter the ground in a corkscrew fashion. The corkscrew character of the attempt to dig into the ground produces a resisting force and a resisting couple. The rider, who persists in executing the  $\beta$ -rotation, has this couple to overcome, besides the performance of that work which is merely due to his raising certain masses, each to a certain additional height above the ground. This work is connected with resistance of the ground to penetration and the work done in calling the couple into action is an independent added work.

Many a bicyclist may have felt this difficulty in working the handle without thinking of the causes. He may have fancied that the handle merely stuck, and that the fault was in the make of the machine or in the want of proper lubricants.

Again, let a bicycle with its rider be suspended off the ground. This could be done by one cord suitably placed. But we may suppose two cords used and then the arrangement will be easier. One cord might pass up just before the rider's face and the other could be somewhere behind him. Let the bicycle rider look due west. The cords are fastened to two points in a level beam of a roof. The cords are parallel and, in a vertical plane, due east and west. Such a plane is sometimes called the prime vertical. Now let some bystander turn the bicycle, so that the rider looks N.-W., or in any direction other than due west. This turn requires an effort, and when the bicycle is released it swings back and finally recovers its old position. As a matter of fact, the turning the bicycle did to some extent lift it. This was one reason why an effort was needed, another but less important reason was that each string suffered a twist or torsion.

Now let us equally lengthen the supporting cords. In other words, let us suspend the bicycle from a higher roof. Then a less effort will be necessary to turn the bicycle into the same N.-W. (or other) direction as before. We may, therefore, by supposing two long fine cords to be employed, represent to ourselves a case where a very little effort is needed to turn the bicycle. This turning effort is not a single force, but rather two forces, constituting a couple. If we use the word force in the general popular sense, we may say that force is always needed to turn a bicycle so suspended, but that the force may be made small by a suitable length of the cords. The effort of turning the bicycle through a given angle is less with long cords, chiefly because the vertical displacement or lift is not so great as with short cords.

Now let the rider on his suspended bicycle be untouched by by-standers or by any other external agency. He is looking due west. He attempts to give his driving wheel a clockwise  $\beta$ -rotation. That is, he endeavours to make that wheel point, say, N.-W. Will the wheel move in the clockwise fashion? It will so move, but he himself and the rest of the machine will move in the counter-clockwise fashion. He exerted on the front wheel a clockwise couple. The reaction is a counter-couple exerted on all the rest of the mass. Thus the front wheel takes a position north of west while he begins to look south of west. The effective  $\beta$  angle is the sum of these opposite rotations. The rider's muscular efforts have altered the internal arrangements of that mass which includes himself and the machine. If the backbone of the bicycle ceases to point due west, the whole machine is lifted temporarily and hence some effort is needed by the rider.

Now let the machine take its original direction, and let us arrange the hind wheel in a kind of groove, so that this wheel must continue to look due west. Let the rider again give the clockwise  $\beta$  twist. He has now a fixed position to act from on the front wheel. This wheel moves towards the N.-W., but all the rest of the mass remains at rest. It neither rotates nor is temporarily lifted.

Now lower the bicycle to the ground and imagine the cords removed, the bicycle upright and the ground smooth.

If everything is symmetrical, the ground level and hard, and the rider steady, the bicycle will not fall. Let the rider give the  $\beta$  twist. The front wheel rotates one way. The rider and the rest of the machine rotate the other way. The lighter front wheel may rotate more quickly than the other compound and heavier mass. The rotations, however, do not depend merely on the masses, but also on their distribution.

Let the bicycle be upright and the ground rough. The rider's twisting effort tends to make the front wheel slew round one way, and the rest of the machine to slew round the other way.

Let the bicycle be travelling upright when the rider gives the  $\beta$  twist. The tendency is for the front wheel to slew round one way, while the rest slews round the other way.

Finally, let the bicycle be travelling at a slope  $\theta$  when the rider gives the  $\beta$  twist. The tendency is for the front wheel to change the track in one direction, while the rest of the machine tries to change the track in the other direction. The friction involved in the front wheel change of direction, may be less and indeed much less than that involved in the other. Hence this other change may be resisted by the ground, while the front wheel turn is allowed. This case is then like that of the cord suspended bicycle when the hind wheel was secured by guides. But, though only the front wheel may shew the effect of the twist in actual movements, we must still remember the forces that act on the rest of the machine. Some of these forces are the complements, so to say, of some of the forces that act on the front wheel. These latter forces we may call actions. Then the other forces are reactions. The particular way in which the front wheel is kept from digging into the ground would partly depend on these actions and reactions.

### THE OYSTER REEF LIGHT-HOUSE.

NOTE BY LIEUTENANT-COLONEL W. G. CUMMING, R.E.,  
*Superintending Engineer, Lower Burma.*

THE iron screw-pile light-house on Oyster Reef,—vide illustration—constructed in 1875-76, was totally destroyed by a cyclone in May 1884, and all idea of building a similar construction on the same reef, or of placing a light-ship on the reef itself, has been abandoned.

2. Since the destruction of the light-house a large amount of correspondence has taken place regarding the most suitable method of lighting the approaches to the harbour of Akyab. Opinions of experts, who have been consulted, vary considerably, but as a definite decision has since been arrived at as to what should be done, it will not be necessary in this note to re-consider any opinions of the kind. All that is required is to state the decision come to and to supply such information as may be necessary to enable professional experts at home to design a structure suitable to our wants.

3. The decision come to is to place an iron light-house on Oyster Island, distant 9 nautical miles from Oyster Reef shoal in a north-westerly direction, make it 120 feet high from ground surface to base of lantern, and provide it with a fixed dioptric light of the 1st order visible at from 16 to 18 miles distant. As supplementary to this it has also been decided to replace the 3rd class flashing light on Savage Island light-house, which guards the entrance of Akyab harbour, by a fixed light of the 1st order varied with flashes, and, if feasible, to raise the light-house another 20 feet to enable its light to cross the light on Oyster Island and to be itself visible from a ship's deck at a distance of from 16 to 18 miles. These decisions have met with the general approval of the Board of Trade.

4. I purpose in this note to deal only with the new light-house required for Oyster Island. The question of raising the Savage Island light-house and increasing its lighting power will be taken up separately. It is somewhat complicated, and further information is required to



enable a decision to be come to as to the most economical way of carrying out this part of the programme.

5. I inspected the Savage Island light-house for the first time on the first of December last, and have since been furnished with drawings of it. It is a strong masonry tower built on solid rock with its floor-level at 45.60 feet above high-water mark. The masonry part of the building rises in the shape of a frustum of a cone, 43.50 feet from floor-level to top, on which the cylindrical light-room capped by a dome rests. The focus of the revolving light as it now stands is 98.10 feet above high-water mark. The tower itself tapers upwards very quickly, for whereas the interior diameter of its base is 17 feet, the same diameter at its top is 8 feet only. This, though sufficient for the existing 3rd class revolving light, is not suitable for a light of the 1st order, which requires an interior diameter space of from 11½ to 12 feet. To raise the light-house another 20 feet and provide it with a light of the 1st order the following work would have to be carried out:—

(a) Dismantle 13½ feet of the present tower measured from its top, and build up a cylindrical tower 11½ feet internal diameter and 33½ feet high on the portion left standing; or add a cylindrical tower 20 feet high and 8 feet internal diameter to the existing tower and project the light-room to obtain for it an interior diameter of at least 11½ feet.

(b) Provide a new light-room approved design of at least 11½ feet interior diameter with apparatus complete for a light of the 1st order.

6. Plans and estimates will in due course be made out for this work, for which, however, we have now no funds in hand. The imperial grant for next year of Rs. 1,55,000 including establishment and tools and plant charges, or Rs. 1,24,500 excluding those charges, is for the new Oyster Island light-house, information regarding which will now be considered in detail.

7. Colonel A. M. Lang, R.E., for some years Chief Engineer of British Burma, went carefully into this matter with the information then before him. His views are recorded in an admirable note,\* dated the 21st July 1884, a printed copy of which is attached for ready reference. I have carefully studied this note with the further information now before me regarding the nature of the ground on which the foundations must be laid, and am also of opinion that a cast-iron tower, almost a *fac-simile* of Gibbs' Hill light-house, Bermudas, will best suit the conditions of the case.

8. I notice in paragraph 4 of his note that Colonel Lang assumes generally that the light-house will take the form of a—

(a) solid platform above the sweep of the waves, on which will be grouped—

(b) keepers' quarters and store-room, from among which will rise—

(c) a tower 120 feet high, which will be destined only to carry the lantern with a staircase of ascent thereto, and probably a hollow central case for hauling up stores, &c., to the lantern and in which the clock mechanism weights can fall.

9. In paragraph 5 (a) of the same note it is recorded, in regard to the solid platform assumed to be necessary, that further information is required on the following points:—

(i) the level to which, having regard to the rise of the tide and the height of storm-waves in the locality, the platform should be carried;

(ii) the form of surface of the island and the character of the rock as affecting the question of foundations; and

(iii) the character of the rock as suitable or not for ashlar or for concrete material.

10. Information on the above points, as well as on those mentioned in clauses (i) to (v) of paragraph 14 of Colonel Lang's note has since been received. It leads me to the inference, coupled with what I saw during my inspection of the island on the 30th November last of the nature and quality of the ground on which the light-house will have to be founded and of what I ascertained regarding the possible action of storm-waves on the surface of the island proper, that no solid platform of the kind is necessary, and that it will be more economical and equally satisfactory to completely separate the light-house itself from the keepers' quarters and store-room. In my opinion the light-house proper, which will of course be built in compartments for the sake of strength, should contain no store-room accommodation except that actually required in connection with the light itself. Quarters for the seven Native light-keepers, including cook-room and store-room for their own provisions, can be readily and cheaply built by the Public Works Department of timber or corrugated iron supported on a frame-work of posts and scantlings raised well above ground-level and strongly braced together. Expensive or deep foundations will not be required for these buildings. All that is necessary is to sink the posts to a depth of about 10 feet until they rest on solid ground, and case the portions so sunk with iron or zinc to prevent decay as much as possible.

11. In elucidation of the opinions expressed in the foregoing paragraph I beg to offer the following remarks, partly from my own observation and partly from the careful reports furnished by the Executive Engineer of the Akyab Division from time to time.

12. (a) *Form of surface of Oyster Island and character of the rock as affecting the question of foundations, and the level to which, having regard to the rise of the tide and the height of storm-waves in the locality, the platform to carry the light-house and its subsidiary buildings should be raised.*—Oyster island is situated about 21 nautical miles from Akyab as the crow flies in a west-by-north direction, and is distant 30 miles from the same place by the usual track of steamers. The portion of it above the level of high water of ordinary spring-tides is very small, the extreme length being 700 feet and the extreme breadth 260. The shape of the island is an irregular oval with its longitudinal diameter running east and west. It rises to an average height of 4 feet above the level of ordinary high water of spring-tides, is surrounded by extensive reefs covered by boulders on all sides, which become exposed to view at low water and act as efficient barriers against wave-action. About 10 feet is the ordinary limit between high and low water of spring-tides.

13. The island is nothing but an accumulation of sand and shell and coral *débris* covered with scrub-jungle, and has evidently been thrown up by wave-action passing over the surrounding reefs and boulders. The reef itself passes under the island and is everywhere met with at depths varying from 9 to 12 feet below ground-surface. There is no difference between the composition of the reef under the island and that exposed to view at low water. Both consist of a shaley mixture of stiff blue clay and sand, which becomes hard on exposure to the air. The boulders overlying the reefs appear to be composed of the same materials, but are much harder, from longer exposure to the weather.

14. There appears to be no action of currents against the sides of the elevated portion of the island, for the surrounding reefs act as efficient breakwaters against erosion. On the contrary, as the breakers roll in from all sides, there is a tendency to a further accumulation of sand and shell *débris* mixed with small boulders. The slope along the south face of the island is gentle from the top surface to the reef. The northern face is packed with boulders. I do not think it probable that a cyclonic wave could cover the island to any depth, or

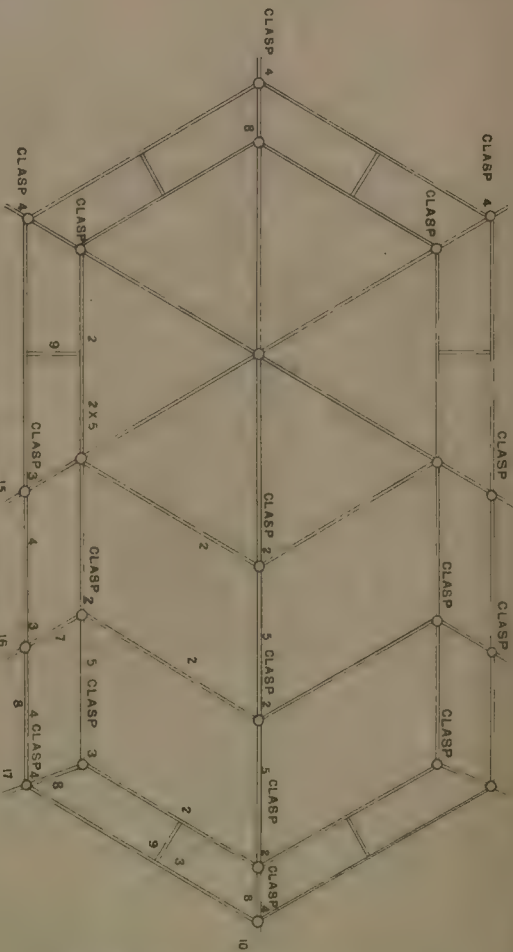
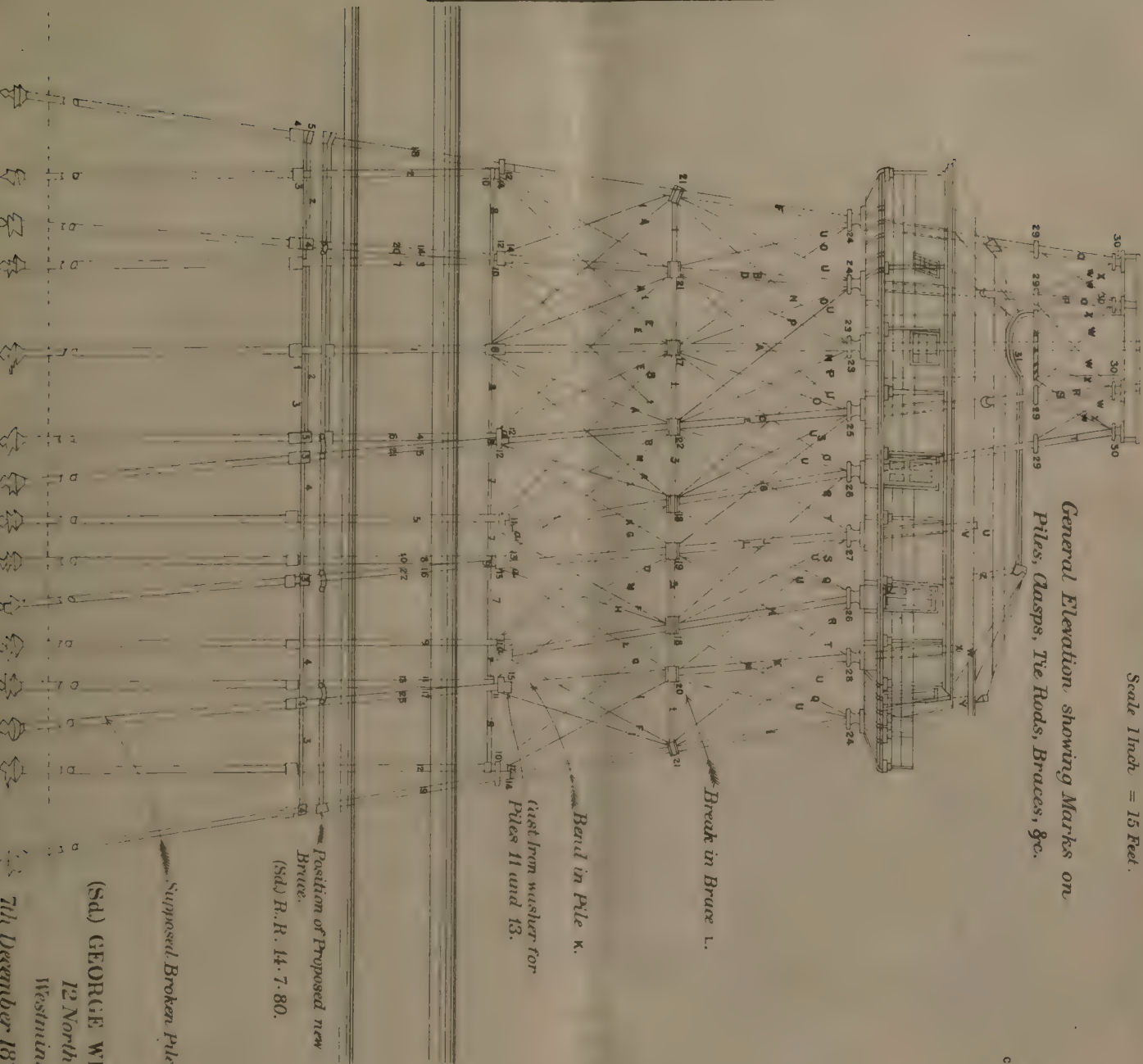
\* To follow.—Ed., I. E.



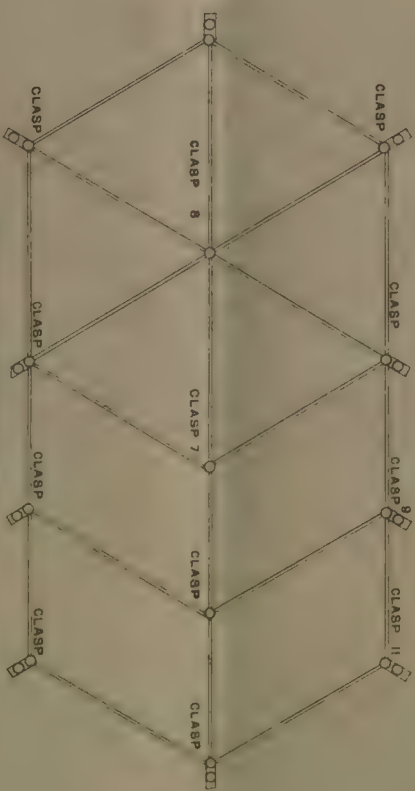
OYSTER REEF LIGHT HOUSE

Scale 1 inch = 15 Feet.

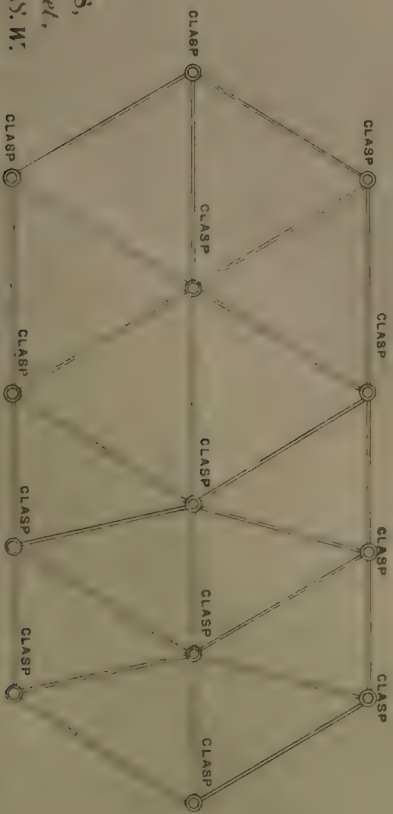
General Elevation showing Marks on Piles, Clasps, Tie Rods, Braces, &c.



Plan of L Iron Braces.



Plan of Round Iron Braces.



Plan of T Braces.

(Sd) GEORGE WELLS,

12 North Street,

Westminster S.W.

7th December 1871.







wash away the accumulation of which it is formed. The spot was visited by Messrs. Lackersteen and James, Provincial Engineers, shortly after the heavy cyclone of 1884, which destroyed the screw-pile light-house on Oyster reef, 9 miles distant from it in a south-easterly direction, and no signs were then visible of any wave action on its surface. I went carefully into this matter when inspecting the island on the 30th of November last and saw no trace of any cyclonic wave ever having reached the island proper, or of any signs of erosion on its shores. The natural protection to the island afforded by its surrounding reefs points to the improbability of any such contingency. I think, therefore, that it may be taken as an established fact that any properly designed and properly built light-house on this island is safe from the action of storm-waves, provided its basement is laid at from 6 to 8 feet above ground level. If this be admitted, there will be no need to build the "solid platform above the sweep of the waves," advocated by Colonel Lang, on which he proposed to construct the light house proper as well as the keepers' quarters and store-room. It will, as before stated, be more economical, and equally satisfactory, to construct all subsidiary buildings of wood and corrugated iron.

15. As regards the light-house itself, I am of opinion that its basement floor should not start from ground level as is the case in the Cocos light-house. It should be laid at from 6 to 8 feet above that level and the portion beneath hearted with concrete to give greater stability and security to the building. Whether the cast-iron curved flanged plates, of which the structure will presumably be built, should start from the firm clayey shale below the accumulation of sand and shell *débris*, or whether the light-house should start from above ground level on a circular platform built up from the solid ground below, can best be settled by professional experts at home to whom the preparation of the design may be entrusted. All that seems necessary now is for me to give such information as I possess regarding the nature of the foundations to be encountered and the difficulties likely to be met with in carrying out work.

(To be continued.)

#### NOTES FROM HOME.

(From our own Correspondent.)

THE Royal Commission appointed in 1886 to inquire into, among other matters, the management of the Irish Railways have reported in favor of the compulsory centralization of the whole of the systems into the hands of one company, who shall be controlled by an external authority to be called the Irish Railway Commission, this body having powers to investigate and remedy grievances. It is to be composed of five members, one of whom is to be a representative of the Government. It is further advised that a general scale of rates and tolls should be drawn up which would ultimately be applied to the combined system. Should the present statutory scale of rates and tolls be reduced by Parliament, the shareholders should be protected from loss by a guarantee of the present gross receipts for a term of years.

The Cunard Steamer *Etruria* has just made the fastest recorded passage between Queenstown and New York. She left the former port at 1.5 P.M. on the 16th instant, and passed Fire Island, which is about 35 miles from Sandy Hook, at 9 A.M. on Saturday, the 22nd instant, thus making the passage in 6 days 22 minutes.

The attention of Engineers has been lately called to the question of the construction of light Railways for the development of rural districts, and at the recent meeting of the British Association a paper was read by Mr. T. S. Sellon on the subject. The author advocated the extension of the present Tramway system now in use in most of our principal towns, as feeders to the trunk lines of the country. Such lines could be carried in many instances along the strips of waste which are so often found bounding country roads, thus saving the heavy cost which is entailed by the purchase of land in the ordinary system of Railway construction. The subject is to be also brought forward by the Society of Engineers at their next meeting, when a paper is to be read

by Mr. Lawford on "Light Railways." One or two of these road Railways, or rather Tramways, are in course of construction, and owing to the absence of stations, signals and telegraphs, and the small staff required, their working expenses are said not to be excessive.

The Southend Local Board are about to construct a new pier in place of the present unsightly wooden structure, the total cost of which will amount to £60,000. The contract is divided into three sections, the first being for a double decked pier, about 200 yards in length, from the existing approach up to and including a spacious concert-room capable of seating over 1,000 people. The Tramway in this section will be below the promenade, which will be about 40 feet wide. The second section is a combined Tramway and promenade pier, about a mile in length, *viz.*, from the concert-room to the present pier-head. This will be 20 feet wide, 12 feet being reserved for promenading purposes and the remainder for the Tramway. The third section is a handsome and extensive pier-head to be erected just outside the present one, and having three landing stages suitable to the different sets of the tide whilst it will be of such a shape as to afford shelter for yachts and other craft. Waiting and refreshment rooms and other conveniences will be provided. The main portion of the pier will be built of iron, but the pier head will be made of wood. The Engineers are Messrs. Brunlees and M'Kerrow of London, under whose superintendence the work will be carried out. It is proposed to work the Tramway by electricity.

The General Report of the Board of Trade for 1887, which has just been issued, shows a satisfactory increase of traffic on the Railways of Great Britain amounting from all sources to over £1,350,000. The decline in the receipts from the 1st and 2nd class passengers, which commenced in 1880, still continues, and it is to the 3rd class passengers that the Railway companies owe the bulk of their passenger receipts. During the past 10 years the receipts of 1st class passengers have decreased 30 per cent., the 2nd class 23 per cent., whilst the 3rd class on the contrary has increased 31 per cent. The increase in the receipts of the 3rd class traffic in this time is nearly three-quarters of the whole amount now received on the 1st and 2nd class together. One noteworthy feature in the Report is the large increase in the receipts from season ticket-holders, which amounts to 53 per cent., this is largely owing to the liberal terms and the good train service now offered by the various companies in the suburban districts.

Some interesting experiments with new explosives have been conducted upon an old armour clad, the *Resistance*, moored off the eastern end of the Isle of Wight. The experiments consisted in firing live shells filled with powder, gun-cotton, melinite and a new explosive, the property of the Elswick Ordnance Company, named dyddite, against the 4½ inch armour of the sides and bulkheads and the unprotected parts of the ship, the only difference from former experiments that have been made being in the gun. At the last experiment the firing was from the 6-inch breechloader, but at the present experiment the 8-inch 14-ton gun was employed, which discharged a 210lb. projectile, with a full charge of 118lb. of powder, and which can penetrate 15½ inch of wrought-iron at 1,000 yards.

The Lancashire and Yorkshire Exchange Station at Liverpool has been superseded by a new structure which has just been completed. The old station, dark, cramped and inconvenient was approached by a flight of steps, the rails being a considerable height above the street level. The new station has been erected on the street level, and presents a very handsome appearance. The total cost amounts to nearly half a million of money. The interior of the station is very handsome. There are two platforms each about 600 feet in length. A large hotel has been built at the entrance to the station in Tithebarn Street, and which is the first of a series the Lancashire and Yorkshire Railway Company contemplate erecting at their more important termini.

#### AMERICAN ENGINEERING NEWS.

(From our own Correspondent.)

ANOTHER St. Louis Bridge is talked of across the Mississippi River to be built at North St. Louis. Congress several years ago granted a charter for the new bridge and the city has given the necessary right of way. The construction of this bridge will give terminal facilities to several



additional railroad companies who are now seeking an entrance to the city.

The problem of placing electric wires underground is now occupying a great deal of attention and study among the Municipal authorities of our larger cities. Indeed, some of our smaller towns are far ahead of many of our large cities in the more modern improvement of electric lighting and motors for street Railways.

Chicago has the honor of proclaiming that it has more subterranean electrical service and a greater mileage than any other city. The system in operation there is what is called the Dorsett. The conduits are made of a special form of asphaltum concrete, and Engineers who have examined it say it is practically indestructible. There are seventeen miles of this conduit in Chicago, containing 150 miles of wire. This is owned by one company, and besides there are six other companies who have in all over 900 miles of wire laid underground. The City Electrician says there are no aerial electric wires in the city. The city owns 6,604 feet of conduit, 19,226 feet of iron pipe, 1,200 feet of wooden trough, 73,731 feet of cable, 9,000 feet of 3-inch sewer pipe, all containing 65 miles of single wire.

The merits of many subway systems have been investigated for the City of Philadelphia, and in 1886 the work of constructing a 5,200 feet conduit was commenced. It is built under the sidewalk and thus far it has worked very well and satisfactorily, and is in many respects a demonstration of the feasibility of underground service for electric lighting purposes.

There is a Commission in New York City to attend to the placing of wires underground. The Chairman of the Commission recently said of the construction:—"The material to be used in the construction of conduits was to be considered only as to its strength and durability as a protector for electric cables. The practicability of operating electrical wires underground is now settled." The Commission is now at work constructing conduits, and the result will be that within a few years all the electric wires in New York City will be operated underground. The result of the experience is that electric wires can be operated as cheaply and successfully under the ground as overhead. The subway on one of the principal thoroughfares is completed for a distance of over two miles, and consists of twenty-four conduits and cost \$60,000 per mile.

In Washington the National Government authorities are forcing the electrical companies to place their wires underground. No particular system is suggested, each company is left to adopt such plan as best suits its requirements. That adopted for arc lighting wires consists of a wooden trough in which insulated conductors are laid side by side, the wires being separated from each other by the use of bituminous bridges 18 inches apart. The trough is then completely filled with bitumen making a solid insulating mass impervious to dampness.

Other cities have taken up the subject, and it is only a question of a few years when scarcely a wire will be seen on poles in any of our cities. Boston, Brooklyn, Buffalo, Detroit, Cleveland, St. Louis, are all agitating the subject.

At the eighth semi-annual Congress of the National Electrical Association, now being held in New York City, President A. S. Duncan, in his opening address, said:—"Three years ago the membership of the Association was only 60, now it is 300. During this time, there has been a vast increase in the uses of electricity throughout the country. There are now 192,500 arc lights and 1,700,000 incandescent lights in use in the United States. There are 34 electric Railways in use running 223 motor cars, and there are 49 more roads under way. In three months there has been added to the capital employed in electric lighting and motor companies \$42,200,000."

Benjamin Baker, M. Inst. C. E., has been recently examining the Hudson River Tunnel, which was begun some years ago by the North River Construction Company. He and another English Engineer have examined the tunnel, and it is reported they have taken it in hand and will push it towards completion.

It is also reported that \$12,500,000, in 5 per cent. debenture bonds is now being raised in London. Active work is soon to commence. It has been shewn that there are no practical difficulties in the way of making the tunnel, the only thing which stopped the work before being the want of a first-class Civil Engineer and funds to carry on the work.

In the City of Chicago experiments have recently been made as to burning the garbage of that city. Last Spring the garbage furnace began operations and your correspondent has recently come across an article in the *Chicago Tribune* giving some testimony as to the success of the experiment. The furnace is built up from a ledge in a stone quarry, the flat roof being nearly level with the grade of the street. Upon this roof teams are driven, the loads of garbage are dumped into chutes running to the floor below, and through other chutes coal is dropped to bed rock of the furnace room, some ten feet lower. There are two furnaces in the building, but one has been found amply sufficient thus far to burn the supply furnished and without working it to its full capacity. The Assistant Health Commissioner reported in the Spring of this year that they were then cremating 50 tons, or yards, per day, and could without any trouble burn three times as much. He said that the works were perfectly satisfactory and met their expectations, except in the case of fuel. Originally the estimate was that about four tons of soft coal would be required per day to run the furnaces to the limit of capacity. It now requires from seven to eight tons per day, the amount of fuel depending largely on the quality of the garbage. If potatoes and turnips which have spoiled on a dealer's hands are tried, intense and protracted heat is required, on account of the large percentage of water contained in those vegetables. Dead cats and dogs, etc., on the other hand, contain enough carbon to burn themselves up and something else besides, provided they are encouraged. The cost will be less in Summer than Winter, because the garbage will be more inflammable. The Commissioner further states:—"We started out with the idea of erecting furnaces of sufficient capacity to consume all garbage collected from the West Side of the City, and I think we have that capacity. But we found that merchants were constantly having large quantities of decaying vegetables on their hands, often offensive, which they had great difficulty in disposing of in any sanitary way, and, as we had ample capacity, we determined to come to their relief. During cold weather we could not get any considerable portion of the West Side garbage to the furnace in a suitable condition for combustion. Garbage, ashes, cinders, oyster cans, beer-bottles, and old clothes, were heaped up and frozen into a solid mass, so that they could not be separated. Warmer weather will change these conditions."

Several complaints have been made about odours from the smoke stack, but on investigation it was found that the furnaces had not been running during the days complained of, because there was no material on hand. The complaint was a mistaken one.

#### N.-W. NOTES.

(By an Outsider.)

THE remnant of the Conference had a fairly good time on the Brake trials. The meals in the mess carriage were for the most part pleasant ré-unions, and the ice only failed once.

Down-country Delegates didn't seem quite satisfied that several hundreds of miles of howling wastes are flanked by rich tracts of irrigated land, and more than one energetic Engineer seemed to itch for the chance of combining Railway works with Irrigation schemes that should make the desert smile.

The new Chenab Bridge, of which Mr. F. J. E. Spring, a well-known Calcutta Engineer, is in Executive charge, was reported to have made a very good start, but the site was not visited by the Conference train, as it was timed both ways to pass Mooltan in the dark.

At Sukker a happy day was spent visiting Mr. Diernecki's workshops, and the magnificent Sukker cantilever bridge. This work is making rapid strides under the skilful care of Mr. Robertson and his able assistant Mr. Hecquet, and if all goes well, by next year's high floods the very ingenious ferry arrangements for taking carriages and wagons across the Indus will be a thing of the past. When the river channels shift about, such ferries have their dark days, but that they can be made wonderfully efficient in favorable cases is shewn by the fact stated that a few days ago 397 vehicles crossed the Indus during the then 15 hours of daylight. Electric light arrangements are fitted up, but at the rate of progress quoted, they could never be required for ordinary traffic.

There is a beautiful view from the top of the bridge towers, some 200 feet above water-level, and doubly interesting to



Engineers who then saw the details of Mr. Robertson's ingenious and effective hoisting machinery. Later in the day the Delegates viewed from the deck of a steamer kindly placed at their disposal, the operation of hoisting a girder web some 80 odd feet long, weighing fifteen tons. In the course of an hour this huge mass was hoisted, hauled over and landed in its final position where it slopes downwards from a height of 200 feet to perhaps one of 150, with the most exact precision, apparently under the guidance of a few hand signals given from his boat by Mr. Hecquet and with far less noise than it takes to manœuvre a penny steam boat.

Those who visited the Loco. Shops, saw and heard a good deal in connection with the long run system, by which mail engines run through between Sukker and Kurrachee, some 320 miles, changing drivers, of course, along the route.

Next day, the ascent of the Harnai Ghât, General Browne's *chef d'œuvre* was performed by most of the party in an open truck fitted with garden seats like the new-fashioned London busses and propelled in advance of the leading engine. The train of 17 vehicles had also a push engine behind. This delightfully novel way of travelling afforded a perfect view all round, free from dust and smuts, and indeed of every discomfort except the heat, which, however, was by no means overpowering.

The view, though fine, was terribly dead and sterile and thoroughly justified Lord Lytton's witty epithet of a camel-colored country.

Above Harnai the grades get steeper and the curves sharper, and the combination of 1 in 43 with curves of, it is said, some 450 feet radius might well make the powerful engines pant stertorously. One very quaint effect is produced by each bridge having one or more large central spans, while the end spans are small. The large spans have broad iron floors that only require paving to fit them for the use of road vehicles, artillery, &c, while the small spans have no floor at all and are no wider than the rails and sleepers. The appearance of a fine broad bridge thus cut off entirely from the land is exceedingly peculiar and unsatisfying.

Above Sharigh, while we came upon an engine changing station in the wilderness, the hills on the left hand contain a seam of coal tilted up at an angle of some 40 degrees. The fuel is clean to the touch, but when burnt has an abominably foul odor, and the lot of any passengers stuck in a tunnel behind any engine that burns the Khosht coal is not likely to be a happy one.

Clinging to the left side of the valley, we pass three mighty rifts that intersect an otherwise smoothly rounded hill, the Chupper Mountain on our right. So clinging and even climbing we ascend close to the head of the valley and then double back in a still climbing horse-shoe curve, and instead of skirting the rounded hill in an open cutting, we run into a tunnel so thickly roofed with rock on our right side, that at each of the numerous oblique *oils de beef* one is thankful that the vigorous blast from the engine's funnel doesn't blow the tunnel's flimsy roof up to fall again upon the train.

Emerging from this Karez tunnel, which the punster of the party insists on calling Karezy, we find our course still returning on, and climbing the far side of the valley, till it crosses the first rift on the Louise Margaret Bridge, a work of no great height as to the piers, for these stand on rocks far, far above the bed of the narrow gap under one of the spans. Like Columbus's egg trick, it is rather a disappointing performance, *after it is done*, but you may be sure the erection was no easy matter in such a place and such a climate before the Railway got there.

Beyond the Bridge another Karez tunnel set deeper in the solid rock turns us round at right angles and brings us into daylight on the right scarf of the great rift, and certainly a more uncanny place to take either road or Railway through cannot well be imagined. On your right, terrific cliffs jut out half over the line in places, while the slope of *débris* on your left run down to incredible depths. Here and there odd stones, up to a ton or two in weight, lie on the side of the formation and seem to indicate the sort of hail-storm to which the locality is liable; and further on the vertical wall of rock takes one horizontal step forward and entirely bars the further open air path.

To make an effective model of this interesting place, take the slab of paving stone in front of your door, and with it your nice white stone door step, and turn both these objects

as they stand up on edge, so that the pavement stands on your right and the rise of the step in front of you. Pile a mound of sand half way up against the paving stone and form a line of Railway along its summit that enters the rise of the step by a tunnel. Let the half of the door step and of the paving slab that stands above the Railway be, say, 400 feet high, and the width, *i.e.*, the rise of the step be, say, 30 or 40 feet. On this scale the outer wall of this tunnel, the piece of rock that is between the Railway and Eternity, doesn't look at all too strong for its work, especially when you espy far overhead a crevice running down between the door step and the pavement for, say, 200 feet or so from the top.

Viewed from the open car, these imposing cliffs and jumbles of mountains, cracked and tossed about, are liable to take the conceit, if there be any, out of Engineers at large.

The Harnai Railway, and indeed all the Railway works in India, are but very temporary scratches after all. There is, however, some balm in the Indian Gilead, for those of the party who have lately explored America *via* Japan, and took various routes across the great Western Continent, were of the unanimous opinion that there is never a canon in all the Rockies that can hold a candle to the terrific grandeur of the great Chupper Rift.

After the Chupper the glories of Mudgorge and its embankment, a good 100 feet high, that looks as if a shower of rain might sweep it all away, fall on you, and soon after that, you cross the summit, the two engines get both in front, the gondola car goes behind and the drivers alone have the pleasure of noting the dangerous entrance to Fuller's Camp Station, which they have happily nick-named Fool's Camp.

Man, it has been observed, is prone at times to play fantastic tricks; and the Engineer of the comparatively easy descent upon Bostan, seems at a first glance to have been at that game when he made his corkscrew spiral. One naturally supposes such a thing devised to circumvent, and at the same time climb a more or less circular hill; but making a mile of line to avoid embanking across a hollow, may be the right way to treat the case, but it has a very disappointing effect on the spectators.

## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

#### Mysore, October 13, 1888.

Mr. O. V. Norris, Assistant Engineer, Special Improvement Division, Mysore, is granted two months' privilege leave from 10th November 1888, or from date of departure.

#### Burma, October 13, 1888.

Mr. R. S. Strachey, Assistant Engineer, 1st grade, Toungoo-Mandalay Extension, Burma State Railway, has passed the departmental standard examination in Hindustani.

#### Burma State Railway.

Mr. E. H. Clementson, Executive Engineer, 4th grade, is transferred from the Toungoo-Mandalay Extension of the Burma State Railway to the open line, with effect from the forenoon of the 29th September 1888.

With effect from the 1st instant an additional district, with head-quarters at Rangoon, is constituted under the designation of "Head-quarters District" in charge of Mr. E. H. Clementson, Executive Engineer.

Mr. J. H. Monk Smith, Assistant Engineer, 1st grade, Toungoo-Mandalay Extension, has been granted three months' privilege leave, with effect from the 20th September 1888.

Mr. W. Wiseman, Executive Engineer, 2nd grade, Toungoo-Mandalay Extension, is granted two months' privilege leave, with effect from the 6th October 1888.

#### Madras, October 16, 1888.

The following promotions are made:—

Lieutenant-Colonel J. Pennycuik, R.E., from Superintending Engineer, 2nd class, to Superintending Engineer, 1st class, temporary rank, with effect from 1st October 1888.

Lieutenant-Colonel R. R. E. Drake-Brockman, R.E., from Superintending Engineer, 3rd class, sub. *pro tem.*, to Superintending Engineer, 2nd class, temporary rank, with effect from 1st October 1888.

Mr. J. W. Martin, from Executive Engineer, 1st grade, to Superintending Engineer, 3rd class, temporary rank, with effect from 1st October 1888.

Mr. J. H. Medlicott, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 1st October 1888.



The transfer of Mr. C. A. Smith, Executive Engineer, 4th grade, temporary rank, from the North Arcot Division to the Coimbatore Division, notified in the *Gazette* of 31st July 1888, is hereby cancelled.

#### Punjab, October 18, 1888.

Mr. C. E. A. Jones, Assistant Engineer, 1st grade, is appointed to officiate as Executive Engineer, 4th grade, with effect from the 24th September 1888, and is posted to the Peshawar Provincial Division, *vice* Captain Abbott, R.E. whose services are temporarily placed at the disposal of the Military Department.

#### India, October 20, 1888.

*Corrigendum.*—In Public Works Department Notification posting certain Royal Indian Engineering College Students to Madras, for "Mr. Hugh Trowbridge Keeling Charles Mildred", read

"Mr. Hugh Trowbridge Keeling".

"Mr. Charles Mildred".

Mr. J. E. P. Lincké, Executive Engineer, 2nd Grade, State Railways, is granted two years' special leave.

The services of Mr. E. G. J. McCudden, Executive Engineer, 2nd Grade, sub. *pro tem.*, State Railways, are placed temporarily at the disposal of the Government of the Punjab for employment on the Bhatinda-Bahawalpur Railway Extension Survey.

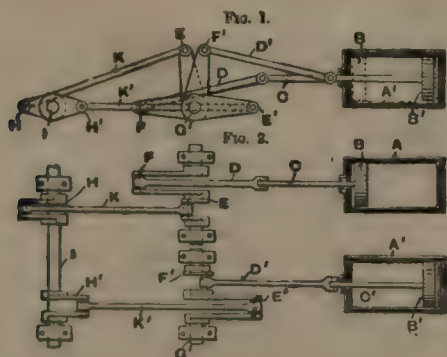
#### Military Works Department.

Lieutenant O. H. Stoehr, R.E., temporary Assistant Engineer, 2nd grade, is appointed to officiate as Executive Engineer, Sialkote Division, Military Works, with effect from the 26th August 1888.

## Indian Engineering Patent Register.

### RECENT AMERICAN PATENTS.

STEAM ENGINES.—W. A. Pitt, *Glenbrook, Connecticut.*—In order to obtain as great an effort on the crank as possible, the inventor makes use of a set of rods which give a constantly increasing leverage on the crank during the stroke of the engine. The figures show an elevation and a plan of the connecting rods and cranks. A A' are the two steam cylinders, and C C' the two piston rods. The connecting rod D is joined to the crank F, and the rod D' to the crank F', and the cranks are keyed to two different shafts. On these shafts are also carried the cranks E E', by means of which and the rods K K' the motion is transmitted to the main driving shaft I. The cranks F F' oscillate in opposite directions, and each moves through one-fourth of a circle at each stroke. The pistons in the two cylinders have a con-



tinuous movement in opposite directions, but with varying speed; the piston B at the commencement of its stroke starts with full maximum power of steam, and with the maximum leverage, and works with a continual reduction of power until it reaches the end of its stroke; during this time the condition and operation of the other piston has been exactly reverse, except as to the maximum power of the steam. During the full stroke the cranks F F' each make a quarter of a revolution in an opposite direction, and the connected cranks H H' each make one half a revolution on each stroke of the pistons; thus one of the cranks on the shaft I and one of the intermediate shafts G G' are always off the dead centre. Five claims are made.—No. 383764. May 29th 1888.

## ADVERTISEMENTS.

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D. P. W. India.

## IMPORTANT NOTICE.

All Civil Engineers of the Department are informed, that, owing to the extended support accorded to the Civil Engineers' Association, the Committee feel it necessary to still further widen their sphere of influence, and to delegate some of their duties.

The current work has been entrusted to Local Sub-committees, who will correspond with the Central Committee.

Every Civil Engineer is urged to write to the Hon. Sec. c/o Grindlay, Groom and Co., Bombay, who will put him in touch with his Sub-committee, with the view of enrolling him a member of the Civil Engineers' Association.

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Cast-iron Fire-bars, Floor-plates, Plain Columns, &c., from	...	" 5-0 " "
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Cast-iron Ornamental Columns, railings, gates, spiral staircases, porticos, brackets, arch-fillings, &c., in great variety	...	At cheapest rates.
Cast-iron Rammers, Road Rollers, Garden Rollers, Sugarcane Rollers, Rain-water Pipes, Axle-boxes, parts of machinery and other castings of any description	...	At cheapest rates.
Water-lifts ... from Rs. 35-0 each, and upwards.	Foundry Pig Iron No. 1	" 445-0 per ton.
Ploughs ... Rs. 4-0 each.	Ditto No. 2	" 2-8 "
	Ditto No. 3	" 40-0 "

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Telegraphic Address—"SILVERGRAY," CALCUTTA.

## COMMERCIAL UNION ASSURANCE CO., LD.

*Extracts from the Twenty-sixth Annual Report viz. for the year 1887.*

### FIRE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£769,265 0 0
Interest ...	£ 19,612 0 0
Losses after deducting Re-insurances ...	£443,587 0 0

### LIFE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£125,559 0 0
Interest and Dividends ...	£ 45,649 0 0
Claims less Re-insurances, ...	£ 79,229 0 0

### MARINE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£175,118 0 0
Interest ...	£ 8,294 0 0
Losses after deducting Re-insurances ...	£138,365 0 0
Interest not belonging to above, but included in Profit and Loss ...	£ 18,545 0 0

The Life Fund was increased during the year by £265,648 and now amounts to £1,070,064.

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the uncalled Capital of £2,250,000.

The rates of Premium are moderate, but they are not unsafely low, and will be found to stand the test of time, thereby in conjunction with the ample Funds affording absolute security to the assured.

The Total Funds and property in hand on 31st December 1887 stood at £2,613,059.

(39)

C. H. OGBOURNE, Manager and Underwriter.

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PAUL DEJOUX, Esq., Executive Engineer, Government Cement Experiment Division, reported:—

"It is the best Ghooting Lime imported into Calcutta."

JAMES KIMBER, Esq., M.I.O.E., Engineer to the Corporation of Calcutta, says:—

"It has been for long past and is now invariably used in all works, particularly drainage works. I have much pleasure in certifying to the excellent and reliable quality of the Lime."

O. A. MILLS, Esq., Executive Engineer, P. W. D., 2nd Calcutta Division, says:—

The Ghooting Lime manufactured by Messrs. Burn & Co. is better than any that can be purchased in Calcutta. I have used it in the construction of many public buildings and have been thoroughly satisfied with it."

M.B.—Our Lime was used throughout all the River Works of the Calcutta Port Commissioners.

## BURN & CO.,

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7, Hastings Street, or Raneegunge.



## Notices.

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General correspondence, and all communications bearing upon literary matters, should, as heretofore, be addressed to PAT. DOYLE, C.E., Spence's Hotel, Calcutta.

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# INDIAN ENGINEERING.

SATURDAY, NOVEMBER 3, 1888.

## CIVIL ENGINEERS—ROLL UP!

We are glad to observe that a new vigor has possessed the Civil Engineers of the Public Works Department,—or, at least, those among them who are at all mindful of the future, and feel any concern as to the present. We therefore consider this a most opportune moment to ask every Civil Engineer in the Department what amount of *esprit de corps* he has shewn, what he has contributed in the interests of the agitation—and to some few, whether they are so unambitious—so sunken in the mire of indifference—as to prefer to wallow in their present prospects? Wake up! Let every man satisfy himself, which he can easily do, as to the earnestness and the true objects of the agitation. If he has sincerely done this, we believe he cannot withstand the impulse of his mind to band himself with his brother Engineers and to help them both pecuniarily and with other marks of encouragement in their task. He cannot, with any conscience, look round without casting a glance of gratitude at those men who have spared neither time nor trouble to achieve several results, not the least important of which is the recognition of the Engineering Service as a Department separate from the Uncovenanted Services. We cannot believe there are any who would devour and easily digest the fruits of other men's labor, they themselves not having rendered any assistance. Some may have been unreasonably in doubt as to the extent of the benefits they would personally derive: others from sheer indifference have shirked their share of duty! But whatever the causes were, let bygones be bygones. We ask all to realize *now*, that the issue affects every single member of the Department. It is not merely a matter as to whether one man or another is to get a sterling pension: the present redoubled effort is with the object of securing a fixed value to the rupee pensions, to enable men to retire upon an income which does not fluctuate. It is just the want of this certainty that chokes the outlet at the top, and consequently causes stagnation in the middle and lower strata of the Department. Roll up! Lose no time. Let each province and administration vie with the others to shew the highest figure of merit. And let no man earn unenviable notoriety by standing out.

## AMENITIES OF A BUREAUCRATIC GOVERNMENT.

WHATEVER may be the effect of a bureaucratic Government on its subjects, there can be no manner of doubt whatever that it confers some substantial benefits on the members comprising it. Power may be exercised either in serving a friend or crushing a foe with equal facility. In order to mystify the public a stalking horse is used, behind the cover of which deeds of darkness may be done with impunity, and the odium attaching to the act removed from the guilty party to the



shoulders of other and innocent men. The stalking horse generally employed for the purpose are those mysterious words "Government of India," what they really signify is the administration of the country by the Governor-General with the assistance of a Council. But in this machinery there are wheels within wheels, and advantage is taken of the complication to let fly an arrow in the dark under the sign manual of the "Government of India," though the Government itself know nothing of the affair. Cases like these go far to discredit an Administration which can make such things possible. If it were a solitary instance we might have passed it over in silence, but as the trick is a common one, no good can be done by repressing any case, especially when it involves a glaring injustice to a public benefactor.

Our readers will recollect the illustrations we gave in this Journal a short time back of the Victoria Terminal Buildings. These works were carried out by Mr. F. W. Stevens, a well-known and highly appreciated Architectural Engineer of Bombay. In this connection we had mentioned that the G. I. P. R. Co. had given him a bonus of £500. This seems to have been partially incorrect, inasmuch as that Company had sanctioned Rs. 5,000, and recommended to the Government of India that he should be paid this sum. But the "Government of India," which had no opportunity of judging of the merits of Mr. Stevens' work, was pleased to take another view of the matter, and in reply to the Secretary of the G. I. P. R. Co. they are pleased to refuse sanction for the payment of a bonus on the ground that Mr. Stevens had, in their opinion, been amply remunerated for any work he may have done in connection with the Victoria Terminus. This is adding insult to injury, considering the work he has just completed is one of the most intricate and extensive modern architectural works yet erected in India. Now what was the ample remuneration which he had received for "special" services as the Directors of that Company had been pleased to designate them. He received Rs. 250 only per month more than any ordinary District Engineer of a Railway with no special talent, apart from the construction and design of those extensive works, which must have caused him great anxiety and worry, and which required both Architectural and Engineering skill and knowledge. But these were not all. Contemplating them from an economical point of view he should be credited with having completed the whole thing within the estimates. The saving thus caused ought of itself to have entitled him to some compensation, but all these elements of a gigantic success were forgotten when on the opposite scale were thrown a few paltry thousand rupees in recognition of a deserving man's labor. It was simply owing to his tact, care and judicious management of the business that litigation was altogether avoided.

Notwithstanding all these and the strong recommendation of the London Board of Directors in which they raised Mr. Stevens' work, and distinctly stated that they had resolved to present him with the bonus in appreciation of the highly satisfactory manner in which he had carried out the Victoria Terminal Buildings, the "Government of

India" now step in to deprive an honest deserving man of his dues. We should also state here that that was not the only undertaking with which Mr. Stevens was connected; he executed the designs and estimates for the New Byculla Station, Igutpura Church, residences for Railway employes, &c., and all this extra job while he was carrying on the Terminal Buildings. All this toil and trouble he had to meet without the help of even a European assistant.

The "Government of India" should be reminded that in connection with the new Dock in Bombay, the Port Trust had recommended another professional man to their notice and there was no objection then to give him a bonus of Rs. 7,500. Why then should there be an invidious distinction created in the case of Mr. Stevens who had to perform such onerous duties at a pecuniary loss to himself? Do the authorities think that the plan of throwing overboard deserving men is the surest way of encouraging others to go and do likewise? In such cases the safest course to follow is to take the opinion of the Local Government, when the works have been executed, as a guide in the determination of granting a bonus, or in any other way dispensing justice to their subordinates. If this were followed, Mr. Stevens would not have been doomed to disappointment. For the Bombay Government fully appreciating his services, passed the following Resolution, on a request from Mr. Stevens to forward an application from him to the Chief Commissioner, Her Majesty's Board of Works, England, through the Secretary:—"The application may be forwarded, and in doing so His Excellency the Governor-in-Council has much pleasure in placing on record his opinion that the design and construction of the Terminal Buildings for the Great Indian Peninsular Railway in Bombay reflect the very highest credit on Mr. Stevens' skill as an Architect and Engineer. His Excellency-in-Council will be very glad to hear that Mr. Stevens has obtained a suitable appointment in England." Look at this picture and at that. The Government of Bombay, under which Mr. Stevens carried out such extensive works, are pleased to speak in the highest terms of his merits as a professional Architect and Engineer, while the "Government of India" have been pleased to refuse sanction to the payment of a bonus of a few thousand rupees on the ground that the miserable pittance of Rs. 250 a month over and above his salary was an ample remuneration for his trouble.

We have lived to learn, that in order to have our merits recognised, it is necessary that we should have a patron in high places, without whose friendly assistance it is simply out of the question to obtain a hearing, however deserving we may be. This is a typical case, and Indian Journalists, whether European or native, should not allow such an injustice to be perpetuated in open defiance of public opinion. What a spectacle we are confronted with! Here is a Government that is quite lavish with public funds in a vain effort to prop a Journal tottering to its end, and the same Government, probably fired with an ardour for cheeseparing, withholds from an honest laborer the dues he is justly entitled to and which his employers do not begrudge him!



## FAS EST ET AB HOSTIS DOCERI.

## II.

In American educational institutions experiments have been made in sufficient number to shew that the work of manual training in connection with a public school is not only practicable, but easy of accomplishment. In this connection the Honorable W. B. Powell, Superintendent of Schools, Washington, says the experiments referred to have shewn:—

1. "That the scholastic work of the school does not suffer, but rather that it is improved by taking a portion of the time allotted to school-work for training pupils in the use of tools.

2. "That it increases the liking for school-work, for it appeals to and develops the creative spirit, and causes the learner to appreciate the value of improvement by self-activity, and leads the pupil to value his own powers as a self-teacher.

3. "By the health it gives, and cheer it produces in giving variety of exercise, thus relieving the monotony and tedium of school-work, by associating study with what the learner can appreciate as the practical in life, and by changing school-work from a task to a pleasure."

Could fairy wand effect more in the best, truest interests of education? Mr. Powell is enthusiastic from his school superintendence point of view, about the uses and beauties of manual training. It has come, he declares, with very purpose of engraftment on American public school systems. It has come to stay with them. "It has come to harmonize our developing systems as a physical and an intellectual embryo. It has come to make productive all teaching and development, at whatever stage of growth the learner may withdraw from the school. It has come for a greater purpose—to unite the intellectual to the highest physical sense, the sense that is purely anthropological, and thus give to all scholastic earning a fibre which it has never yet possessed."

Girls as well as boys, young women as well as young men are taught handicrafts at American schools and colleges. Besides being posted on scientific subjects and given keys to economic problems, they learn the uses and values of fingers and thumbs. They give evidence of quicker aptitudes for the application of a knowledge of mechanics to practical uses than the generality of school and college going young men do. They make excellent wood carvers, and manufacturers of workmen's tools. At the same time the housewife side of their education is not neglected.

The University of Michigan was formally opened in 1841, and the management entrusted to a Board of Regents. Said the practically minded founders and promoters of the scheme:—"A Board of experienced Regents can manage the funds of the University better than any legislature, and the faculty can manage the business of education—the interior of the college—better than any Regents," an educational dictum excogitated from New World experiences, and worthy of consideration. The student's library at Michigan University cost over 85,000 dollars. The interests of practical science have been

and always are kept well in view in the selection of books and appliances for its furnishment.

In 1863, Ezra Cornell, a self-made man of the people who had been at various stages of his career wood-chopper, farmer, miller, inventor of improvements in ploughs and on Morse's telegraphic system, founded a public library in Ithaca, New York State, the town of his adoption as an American citizen. This public library became corner stone of the Cornell University—promotion of study in agricultural affairs being its speciality. Besides a handsome gift of land, Mr. Cornell dowered it with half a million dollars in hard cash. New York State added a million dollars to the endowment. The public came forward generously with subscriptions. And thus Cornell University was established on a sound monetary basis. Prominence for practical scientific studies was one of its main formative ideas. Therefore, it has special departments for Civil Engineering, mechanical arts, the art of trade, mining, etc.

In 1876, the Johns Hopkins University was opened at Baltimore for the promotion of scientific education. It has, attached to it, a Geographical and Statistical Bureau where are kept maps, charts, diagrams, etc., illustrative of the course of studies pursued. The atlases and smaller portfolios are kept upon slides arranged one above another in a tier, so that the titles of the folios can be easily seen. A good idea. Survey and Railroad Reports, and the journals of scientific societies are assiduously collected from all parts of the country, and are always available for use by students in the Library Reading Rooms. The former can boast of possessing 90,000 volumes. Technical education is well-cared for at the Johns Hopkins University. It is rich in its collection of pamphlets bearing on economic subjects, and has a "Newspaper Bureau," as well as Geographical and Statistical Bureaus. It has a Museum of its own, and is within easy reach of those at Washington—a proximity turned to good educational use and affording unaccustomed texts for popular "object lessons."

Vassar College was founded in 1861, and was designed, in the founder's words, "to accomplish for young women what our colleges are accomplishing for young men." It aims at giving a thorough collegiate education. It maintains thirteen professorships and a large staff of assistant teachers. It has a well equipped astronomical observatory, a chemical and physical laboratory, a library blessed with a permanent yearly income dedicated to the purchase of books, an art gallery, a school of music, and a school of painting. Who would not like to be an American young woman just for the sake of being privileged to go to such an Educational Paradise?

Wellesley College (Wellesley is about 15 miles from Boston) is another popular institution for the education of young women. It stands in a park of over 300 acres; and the main building is 475 feet long, 150 feet wide, and five stories high. The library contains 30,000 volumes. Much attention is paid to the study of political economy; but not much apparently to manual training. To the Smith College, Northampton, Massachusetts, the same



remark applies. Bryn Mawr College, founded by a Quaker, Dr. Joseph Taylor, of New Jersey, was opened to students three years ago. Its President says, "Perhaps no change in modern collegiate instruction has been more amply justified than the greater importance given to history, and to political and social science."

The Wharton School of Finance and Economy aims at giving a thorough general and professional training to young men who intend to engage in business, or upon whom the management of property will devolve, etc. There is a special course in economic science. So there is at Wisconsin. Rutgers College, the Syracuse University, the University of Pennsylvania, the Washington High School, and many other educational institutions in the United States include technical education in the scholastic curriculum they administer. It is recognized throughout the United States as an essential branch of study in schools and colleges dedicated to the service of a sovereign people. That is why outcome of American workshops has grown to be, in the whole, superior to English outcomes, as well as cheaper. American brains, eyes, hands are all bent towards profitable utilitarianism, from youth upwards. English workmen never get such a training. They are conservative and hold fast to the obsolete traditions of the Elders; are lacking in power of adaptation, in pliability of thought, in manual dexterity. They get beaten, therefore, when competing with their American rivals. Times have changed for them; but they have not changed with the times; and human nature has a way of railing at fate for misfortunes of its own bringing about. It were better to follow after good example than to rail.

Beginnings have been made towards encouragement of Industrial Institutions and Technical Schools in India, but like all other good intents in this enervating climate the scheme languishes; is sadly in need of an infusion of effort. There is no valid reason why this should not be forthcoming. Many of the industrial teaching foundations referred to in this writing, are situated in the southern states of America, and thrive and do good work under as hot suns and as enervating climatic conditions as afflict us in India. Let our educational lights and authorities take warrant and action for promotions of technical education throughout their Instructional Satrapies. Let the natural handiness, and thumb, finger and toe dexterity of Indian work-people be encouraged, and guided into useful grooves. And let employers of skilled labour, business men, all who are, and all who ought to be, interested in Indian faculties for good work and self-support, bestir themselves to keep the ball of practicality rolling when once it is set in motion; to hinder and prevent the national tendency to lapse into laziness and *laissez faire*. And let us, on our own behalf, remind all parties concerned that *Bis dat qui cito dat*. Or, if sentimentalism has to be propitiated, here is another proverb which found favor with the practically minded Romans, and which has not yet lost its sentimental savour—the proverb *Laborare est orare*.

## Notes and Comments.

**RE-OPENING OF A PROJECT.**—The Government has arranged to re-open the Rushikulya project as a relief work.

**MR. DUFF-BRUCE.**—It is stated that this gentleman having succeeded to a large Westminster practice, will not return to India.

**ELECTRIC LIGHTING IN BARODA.**—H. H. the Gaekwar has given the order for the electric lighting of the Makarpura Palaces to Messrs. Siemens Brothers & Co., of London.

**SOMEWHAT STRANGE.**—We learn that the Bengal-Nagpur Railway people have actually gone to the trouble and expense of importing Pathans for the Tunnel work near Chaibassa.

**THE KHOJAK.**—The Railway works are progressing rapidly. The east "Rope Incline" (Shala Bagh side) is finished, and is a sight well worth seeing. Material, &c., can now be taken up to the Khojak crest by the Rope Incline.

**ANOTHER SCANDAL.**—We learn on good authority that the appointments of "Deputy Manager" and "Manager" on Indian State Railway will hereafter only be held by R. E's. and that orders have been actually issued to that effect.

**THE P. W. D. ACCOUNTS BRANCH INQUIRY.**—Mr. Macdonald has been specially instructed to direct his attention to the cost of the agency employed in Examiners' offices, and to report whether the work required to be done could not, in his opinion, be carried out by a less expensive staff.

**THE COMPANIES ACT.**—A Resolution in the Finance Department reviews the working of the Joint Stock Companies in 1887-88. The number of companies registered during the year was 125, making a total of 910 with an actual capital of 2,223 lakhs. Of this, 966 lakhs is invested in mills and presses.

**DEHRA DUN RAILWAY.**—There appears every chance of this scheme being carried out now that it has secured a very considerable amount of local support. Mr. Duff Bruce, who has been nominated Consulting Engineer in England, should, under the above circumstances, have little trouble in floating the scheme at home.

**AN ITEM FROM NEW SOUTH WALES.**—The third span of the Hawkesbury Railway bridge was successfully placed in position on the piers on 16th August and the fourth on 8th September. Three more spans, each 416 feet long, and weighing 1,000 tons, have yet to be put together and placed on the piers by the end of the year.

**THE STRAITS P. W. D. BUDGET.**—The estimate for the present year is \$1,116,185. As to the particulars of these Works and Buildings, in Singapore it is proposed to spend \$504,000 on Works, and \$112,000 on Roads; in Penang, \$382,000 on Works, and \$178,000 on Roads; in Malacca, \$47,000 on Works, and \$102,000 on Roads.

**VERY TRUE!**—A Contemporary observes regarding the proposed changes and reforms in the P. W. D., that the whole situation is so entirely embarrassing, that till the Government of India boldly attack the question and pursue a consistent policy with their public works, there can be nothing but waste and extravagance, accompanied by injustice, discontent, and irritation.

**BRITISH PATENTS IN 1887.**—The report of the Comptroller-General of Patents, Designs, and Trade Marks for the past year states that the total number of patents



applied for was 18,051, being an increase of about 900 on the year before ; of designs, 26,000 as against 24,000 of the preceding year ; and of trade marks, 10,586, being a decrease of 91 from the preceding year.

**SYNOPSIS OF TRANSACTIONS OF GUARANTEED RAILWAYS.**—A synopsis of transactions of the Guaranteed Railways up to the end of 1887 is published. The actual increase of capital during the last five years has been £4,396,262. The result of the working during the same period is considered satisfactory, the annual result having been converted from a loss of about 17½ lakhs in 1883 to a gain of Rs. 10,70,000 in 1887.

**THE INDIAN EXPLOSIVES ACT.**—The Governor of Bombay in Council, with the previous sanction of the Governor-General in Council, has made rules to regulate the transport of explosives from the port of Bombay to the island in the Thana River on which Messrs. Walsh, Lovett, Mitchell and Company have been permitted by Government to store explosives for the purposes of their contract in connection with the Tansa Water-Works.

**ITEMS FROM SIAM.**—A tramway has been started at Bangkok with every prospect of success. Sir Andrew Clarke's surveyors are actively at work on the projected Railway line he has in hand. Surveys for another line from Chantaboun, on the Gulf of Siam, to Battambang, on the Cambodian frontier, are also being proceeded with by sundry Siamese princes interested in the scheme, who have secured the services of a Danish Engineer for the purpose.

**THE TRAFFIC DEPARTMENT OF STATE RAILWAYS.**—A Resolution has been published regarding the system of recruitment for the Traffic Department of State Railways. Recruitment will be by transfer from the Engineering branch, and the promotion of specially qualified men from the subordinate ranks, the appointment of qualified traffic officers in England under covenant, and of nominees of the Director-General of Railways after passing an examination.

**A PROBLEM.**—We learn from a Hyderabad journal that the new system of water-works in the Residency Bazars has been completed and the pipes laid down, but that the Government of H. H. the Nizam is about to enter a protest against the imposition of a water-rate within the limits of the Residency jurisdiction on the ground that it is contrary to the rule of Islam that water should be charged for. If so, who is to pay the cost of this unorthodox innovation ?

**MINERALS IN BURMA.**—The Chemical Examiner reports that the most important of those examined were specimens of coal and limestone from Pauk in the Pagan District. The examination shewed that they belonged to the nummulitic formation like the Thayetmyo coal. The coal was of good quality, but I have received no particulars of the way in which it is found. Among the remainder may be mentioned iron pyrites, used as an ore of sulphur and gypsum.

**PUBLIC WORKS IN THE COURT OF WARDS ESTATES, MADRAS.**—The expenditure on Public Works in the Wards Estates in Southern India for 1886-87 is unsatisfactory. The outlay of Rs. 1,51,833 bears the insignificant proportion of only 6 per cent. to the total expenditure of Rs. 24,68,461. The outlay on Public Works in the preceding year was Rs. 1,76,161 or 7.43 per cent. of the total charges of Rs. 23,68,594. The expenditure on irrigation works was confined mainly to repairs.

**GOOD ADVICE.**—At the distribution of prizes at the Canning College, Lucknow, Mr. Young, the Judicial Commissioner, who presided, urged the students to be thorough. He said that all great leaders had been accurate observers, and advised the students not to seek learned professions if they had a natural bent for arts or mechanics. The great want of India, he said, was Engineers, Surveyors, and Architects. If a pump was wanted in a town, no man could put one up or repair it.

**AN APPARENT JOB.**—The Howrah Municipality invites tenders for the preparation of detailed plans, specification and estimate for a filtered water-supply for the town of Howrah. It is to be distinctly understood that the Commissioners will not pay anything for these plans, etc., if the water-supply scheme be not carried out. The Commissioners do not bind themselves to accept the lowest or any tender. Tenders will be received up to 31st October and the advertisement only appears the day before!

**TELEGRAPH EXTENSIONS IN THE EAST.**—It may not be generally known that a telegraph line has been constructed between Assam and Burma. The line goes through Manipur and Tummo, and, besides connecting the two provinces, it forms an additional link in the telegraphic communication between India on the one side and China and Australia on the other. As regards China more direct communication will probably before long be available, as a Chinese line from Peking has nearly reached the Burmese frontier at Bhamo.

**THE BOMBAY P. W. D.**—A correspondent writes anent the recent Bombay P. W. D. Resolution:—"I am sick of the whole show as run by the amiable and talented but utterly inexperienced blundering Dutchman." Another correspondent writes:—"The Under-Secretary spoken of (Mr. W. C. Hughes) now in nomination for Secretary to Government, has 20 years service not 18 as stated. He is 11th on the list of 2nd grade Executives, thus going over 10 men in that grade and over the whole of the 1st grade."

**THE INDIAN MINTS.**—A Resolution on the working of the Indian mints for last year states that the net imports of gold into India that year amounted to Rs. 2,99,24,810 against Rs. 2,17,70,652 in the previous year. The net imports of silver amounted to 931 lakhs and 1,079 lakhs were used in coinage. The coinage of copper amounted to Rs. 17,03,369, and the gain on copper coinage amounted to Rs. 9,03,187. The mints are worked at an average annual loss of Rs. 469,754, which is due entirely to the Calcutta Mint.

**BENGAL P. W. D.**—Mr. W. B. Bestie, lately on privilege leave, has returned and resumed charge of his office as Under-Secretary to the Government of Bengal in the General and Provincial Branch of the Public Works Department from Mr. W. Connan, Divisional Inspector of Local Works, Presidency Division. We hear that Baboo Khetter Nath Chatterjee, M.I.C.E., Roy Bahadur, Executive Engineer of the Burdwan Division, will shortly apply for pension. It is probable that Baboo Haran Chandra Banerjee will be selected to succeed him.

**E. BENEDICT, M. INST. C.E.**—We are glad to learn that this gentleman, who has been so well-known as Chief Engineer of the Eastern Bengal Railway and of the Sind, Punjab and Delhi Railway, has started on his own ac-



count as Consulting Engineer at Umballa. India ought to afford a wide field for private professional practice like that contemplated by Mr. Benedict, and there will be no occasion now for Municipalities and other public bodies having recourse to Government for professional help when such is available from sources deserving of encouragement and support.

**MINING ACCIDENTS.**—We are not a little surprised on finding a leading Calcutta daily allowing itself to be misled on the question of mining legislation for India. It speaks of the subsidence of a dismantled and abandoned mine as a "casualty," and dilates on an accidental death as an exciting cause for State intervention. Irresponsible statements are not conclusive arguments; and the implication that the police are neglectful, the magistracy asleep, the European supervision incompetent, and the mine owners indifferent, is too preposterous to be entertained for a moment.

**RAILWAY LEGISLATION.**—The Honorable Mr. Scoble's Bill to consolidate and amend the law relating to the Indian Railway Bill, aims at securing proper and impartial facilities for traffic, and follows generally the lines of the English Railway and Canals Traffic Acts. The Governor-General is empowered in cases of certain differences arising between individuals and Railway administrations to appoint a Commission to decide such differences. The Commissioners in such cases are to consist of a Judge of a High Court, a Railway expert, and a member of the mercantile community or other persons.

**DESIGNS FOR BRIDGES.**—A set of type designs for bridges was lately forwarded by the India Office for the use of the Public Works Department Engineers in this country, but as the approximate cost and freight to Madras of the bridges was not furnished, the India Office have been requested to supply the required information. Superintending Engineers, in reply to a query on the subject, have also been informed that there is no objection to bridges in accordance with the type designs being procured from makers in India, provided they are of local manufacture, and the price and quality do not differ materially from those of English manufacture.

**FAMINE RELIEF WORKS IN GUZERAT AND KATHIAWAR.**—H. H. the Gaekwar's ministers are preparing measures for meeting in due time the scarcity, if not famine, imminent in his dominions of Guzerat and Kathiawar. Projects estimated to cost in all 8½ lakhs are ready in every detail, prepared by the Chief Engineer besides which the Bahadarpur-Chuta Oodeypur contracts have been let; and the Anand-Petlad Railway has been sanctioned. These works will do much to relieve the pressure in the Baroda Districts. And in Kadi, north of Ahmedabad, the proposed connection of the Rajputana Malwa Railway with Wadhwan will give much needful employment.

**ALEXANDRIA HARBOUR IMPROVEMENT.**—The Egyptian Government has under consideration a proposal for widening the entrance to the harbour of Alexandria, and for increasing its depth to 30 feet. The harbour is also to be so illuminated with electric light as to enable vessels to enter and leave it as readily by night as by day. For the cost of these improvements the Khedive's Government proposes to repay itself by the imposition of a light tax on vessels using the port. This tax will not, it is said, amount to more than about twenty-five shillings per thousand registered tons. The project has already been submitted to some of the shipping associations of the

United Kingdom, and appears to have been favorably received.

**MADRAS RAILWAY!**—During the quarter ended 30th June last about 11¼ per cent. of all trains on the Madras Railway ran late, being 1¼ per cent. more than the 1st quarter of 1888. The most unpunctual train is that between Podanur and Calicut, the running of which has been modified in the time-table about to issue on the 1st September. The next worst train is that between Renigunta and Madras. It is an unimportant train, but it is engaging the attention of the staff. The scrutiny now exercised will, no doubt, lead to better results in time. The Government are glad to observe that the necessity for a higher standard of punctuality is fully recognised by the Agent, and that the subject is receiving his close attention.

**LORD REAY—AGAIN!**—Some indignation has been expressed at Bombay at the appointment by Lord Reay of a Deputy Collector as a member of the local Legislative Council. No objection is taken to the gentleman on the score of his personal fitness, but it is pointed out that a Deputy Collector is subordinate to the Collector of his District, and is bound to obey his orders. For a short period he will enjoy the title of Honorable and assist in framing laws which the Collector will be bound to obey, but when the Deputy Collector returns to his own office he will again become the subordinate. This is considered not only injurious to the interests of the service, but apt to lower the dignity of the Council in the eyes of the public.

**COLONEL LUARD, R.E.**—With the advent of the cold weather, there is the usual return of officers from furlough and leave. There are relieving and reversions consequent upon these returns to duty, and this state continues till early in the following year. It was thought not many months ago that Mr. E. J. Martin was appointed temporarily to act as Chief Engineer and Secretary, pending the return of Colonel C. H. Luard, R.E. We now learn that this officer does not return for the present, that his ambition is not to be a Provincial Chief Engineer, but a Director-General of Railways. It is quite probable, therefore, that when Colonel Conway-Gordon goes on leave next year, that Colonel Luard will appear on the scene and resume work in fields more congenial to his taste.

**AN EXTRAORDINARY CASE.**—In 1886 a Sub-Engineer in Central India on attaining the age of 56 was compulsorily retired on a gratuity, though he required only a few months' service to qualify for pension. It mattered not that he had borne a good character and attained the honorary rank of Assistant Engineer, and was still mentally and physically efficient. He was officially informed by his Superintending Engineer that he must make room for his juniors. An appeal to the Government of India was made against this arbitrary order, but without success. In April 1887, an appeal was made to the Secretary of State, and up to October 1888 he has received no reply beyond an intimation from the Government of India that the case is still under consideration. It is generally believed that this particular case has had something to do with the recent Government order making retirement compulsory at the age of 60 instead of 55.

**QUEENSLAND RIVERS AND HARBOURS.**—In connection with the improvement of the harbours and rivers of Queensland very little but dredging has been done of



late although such works as the construction of the breakwater at Townsville, in accordance with Sir John Coode's recommendations, have been continued. A dredge has gone to Bundaberg to improve the cutting on the Burnett bar. Another has commenced work on the Normanton bar, where it is proposed to make a cutting about 100 feet wide and 4 feet deep. Satisfactory progress is being made with the retaining-walls and dredging in the Fitzroy River, and also with the Townsville works, where the dredge is now excavating a channel between what will be the horns of the breakwater, and will form the entrance to the harbour. Dredging work in the Brisbane River will be resumed. A surveyor is at present engaged at Thursday Island taking borings and obtaining the information necessary before the proposed jetty is commenced.

**THE "GOOTHA" SYSTEM OF LABOR.**—Orders on proposal to introduce the "Gootha" system of labor on the Pottinghi-Koraput Road Works. On account of the difficulties to obtain daily labor in the Vizagapatam district, a large number of coolies are, and always have been, employed on this system by contractors and native ryots on these hills. A "Gootha" is a man who undertakes to work for his employer for a certain period, generally one year, for a lump-sum payment. The pay of a "Gootha" is Rs. 20 for one year; one half of this sum is paid down and the other half is paid at the end of the year. When a "Gootha" is employed on work which keeps him away from his village, he receives an extra anna per diem. Now the above wages are really small, but the coolies have always been used to this system and like it; there is no forcing, only men who come and offer themselves are ever taken on. Many who have engaged "Gootha" constantly for years have never known any case in which the "Gootha" has failed to work out his time; in fact it is a custom that is always observed that if an engaged "Gootha" himself falls ill, he sends another member of his family to take his place; if he dies the money is returned by his surety, or else the man who stands security for him completes the term.

**INDIA'S PLACE IN THE WORLD'S COMMERCE.**—The question as to where is India to find a market for its productions without a fight for commercial supremacy with interests that India's rulers will find themselves bound to protect, is a difficult one to answer. Take a single item of trade—cotton goods—as an instance. India grows her own cotton, is purchasing the finest of machinery, and has abundance of cheap labor; already English cotton-mills are complaining that they are losing in India one of their best markets. But this does not cover all the trouble. India is reaching out for the trade of her neighbours. Bombay mills are already sending their yarns and cotton cloths to Japan and China, and their plain goods are regarded by native buyers in both markets as superior to anything sent them from Europe. Thus far the principal work of the British has been the education of the natives to such a condition as to enable them to take a proper place among the world's most intelligent nations. With the development of their intelligence, however, will come the natural tendency toward a higher plane as producers, as a nation capable of occupying a better position than that of hewers of wood and drawers of water for the governing class. The opportunity they seek will ultimately be found in the establishment of a foreign trade. The question is at whose expense is it to be developed?

## Current News.

SIR CHARLES ELLIOTT is being treated by Dr. Leahy, and is progressing favorably.

THE new light house erected at Damaun was lighted for the first time on the 16th instant.

THE cable to Australia has been again repaired, and through communication is re-opened.

LIEUTENANT-COLONEL T. WALKER, R. A., is appointed Superintendent, Gun Carriage Factory, Bombay.

A TRIAL of the Westinghouse Automatic Brake will shortly be made upon the Eastern Bengal State Railway.

COLONEL F. CODDINGTON, Deputy Superintendent in the Survey Department, goes home shortly on a year's furlough.

MR. T. R. WYNNE is appointed Lieutenant-Colonel Commanding the Bengal-Nagpur Railway Volunteers, and Mr. T. Wright, Major.

FURTHER experiments with the Vacuum Break were tried this week on the Eastern Bengal Railway, between Sealdah and Kanchrapara.

THERE is good reason to expect that the Indian Court in the Paris International Exhibition will be both interesting and instructive.

SOME new rules have been published in the Punjab in connection with the Famine Code, which have been approved of by the Governor-General.

DR. W. KING, Director of the Geological Survey of India, has returned to the Presidency after an extensive tour in Southern and Western India.

MAJOR GENERAL T. WHITE, Mint Master, Bombay, takes leave for two months. Major A. Baird, R. E., is appointed to officiate as Mint Master, Bombay.

THE Survey Department has just completed a Map of Upper Burma. Triangulation was also effected over 23,500 square miles, on the scale of 4 miles to the inch.

A GOOD road is now being made across the Jelapla Pass by a party of Pioneers and Sappers. The work is shortly to be taken over by the Public Works Department.

THE rails for the line from Sialkot to Jammu are expected shortly, and will be laid down with all speed. It is hoped to complete this part of the work by December next.

COLONEL J. O. HASTED, R. E., Secretary to Government, P. W. D., having proceeded to England preparatory to retirement, has resigned his seat in the Madras Legislative Council.

ON return from leave Lieutenants F. H. Horniblow and H. S. King, Royal Engineers, are attached to the Military Works Department and posted to the Presidency and Oudh Command.

THE Universities in India propose to give prizes for the study of palaeography, and to make the subject optional for the higher degrees, thus giving encouragement to the study of archaeology.

THE Actinometric Observatory hitherto maintained at Mussoorie is to be transferred to Simla, where it will be under the personal supervision of the head of the Imperial Meteorological Department.

FOUR hundred coolies from Mansera and the vicinity of Abbotabad proceeded to Sophia, under the arrangements of Mr. Fenner, Superintendent Engineer for the road-making operations, for the Ogli Column.

IT is said that the Nizam intends founding a new Mint in Hyderabad. Rs. 50,000 have, it is believed, been sanctioned for machinery, and Rs. 15,000 for buildings, and a monthly sum of Rs. 1,500 for necessary establishment.

PUBLIC works are being carried on with great vigour in Mysore. The grant for next year from the provincial revenues amounts to the sum of 20 lakhs, and 8½ lakhs are contributed by district and general funds. The Chief operations of the department are the repairing of old tanks and the extension of irrigation works.

THE Bolan Railway is expected to be opened for traffic through from Sibi to Quetta as a broad-gauge line in December. The metre-gauge line from Hirock to the summit of the Pass is being replaced by a broad-gauge line; the work on which is sufficiently advanced now to allow of carriages being run through if necessary.



GOVERNMENT have sanctioned the purchase, by the Coconada Groyne's Extension Committee, of a Priestman's dredger for use on the Coconada bar. Permission has been accorded to the Committee making their own arrangement for purchasing the dredger through private agency, instead of through the India Office.

A MEETING of the members of the Uncovenanted Service was held at Simla, on 26th October, Sir Guilford Molesworth presiding, at which the Committee presented the pamphlet setting forth the grievances of the service, which it was decided to draw up some time ago. It was unanimously approved of by the meeting.

## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

### THE PRESENT STATE OF THE INDIAN P. W. D., AND ITS PAST HISTORY.

I.

SIR,—At the present time when, as shewn by the letter which you published in your official correspondence of 13th October, it is evidently intended to remodel the Department, I think it advisable to give a summary of its past history. Without remembering the past it is impossible either to correctly comprehend the present problems or to arrive at any reasonable conclusions for their future solution. I shall criticise the Government proposals in a later issue; at present I will confine myself to the past.

You shewed in your recent articles of 15th September and 30th September what are the deplorable positions and prospects of the Civil Engineers of the P. W. Department, and how the non-fulfilment of the promises of Government and the prohibition of joint memorials had caused the formation of the C. E. Association. I purpose now to give a connected history of the Department and its development shewing especially how the present difficulties have come about, and the line of action on the part of the Civil Engineers which led to the order of 1882 separating Military from Civil works, improved rules of 1884, and the admission of the 64 Indian appointed Engineers to the better rules in 1888.

I believe that many men in the Department are not aware of the history of the P. W. D., and therefore are in doubt as to what is the best action to take to obtain redress of their disabilities. My data are largely extracted from a pamphlet.

For the correct comprehension of the present state of the P. W. D. it is necessary to go back to the year 1855, in which the Secretary of State sent out a few trained Civil Engineers for special works. Others followed in 1858 and in 1859. Lord Stanley (now Earl Derby) arranged for a regular supply of Civil Engineers, to be supplemented by men from the newly founded Colleges of Boorkee, Calcutta, Poona and Madras. These Engineers counted their service from the date of joining their appointments, and although the Stanley Engineers had stamped and signed covenants with the Secretary of State they were arbitrarily classed the "Uncovenanted Service."

The Royal Engineers who had hitherto had (with a few volunteers from the staff corps) the monopoly of the service, naturally occupied all the administrative posts, and no jealousy was felt from this cause. But when repeated promotions of Royal Engineers out of their turn and selection to fill these posts over the heads of Civil Engineers of proved ability, shewed to demonstration that the governing body of Royal Engineers were moved by *esprit de corps* to make all the best appointments in the service an appanage of the R. E. alone, discontent was excited, and the general dissatisfaction rose to so high a pitch that the Government of India issued their circular No. 84. P. W., dated Simla, 6th October 1869, in which they said:—"The Government of India unreservedly declares its complete confidence in the body of Civil Engineers in its service. It has long been, and continues to be, the desire of the Indian Government to recognise their merits and just claims as fully as those of any class of its officers, and its appreciation of them is sufficiently proved by the large addition to the number of Civil Engineers employed under Government during the last two years. Further, so far from there being at the present time any disposition to depreciate the value of the services of the Civil Engineers, the Government of India has recently had before it proposals which it is hoped will take early effect for improving their position generally, and placing them with respect to the emoluments on precisely the same footing as all other officers employed on the same duties." By this time (1869) the Department, which in 1850 consisted of only 183 officers in all, had risen to a total of 896. The Civil Engineers being:—

1856	...	...	...	70
1861	...	...	...	121
1865	...	...	...	251
1868	...	...	...	400
1869	...	...	...	533

The rapid expansion from 1865 to 1869 was due to the new policy inaugurated by the Government of India for a greatly increased construction of Railways and other works, for famine protection and for developing the resources of India. All the Engineers so engaged had been brought on the lists on one footing except that the so-called "Stanley" Engineers engaged by the Secretary of State in England had written agreements or covenants, while the men engaged in India had not. Many of the latter, however, were Engineers with English training who had been appointed in India, though not through the Indian colleges. By the following year (1870) it was found that the supply of candidates for posts in the P. W. D. had, owing to their exclusion from administrative posts, and to their being placed, in spite of their covenants, on the footing of the Uncovenanted Service, fallen off so much in number and quality that if public works were to continue, some action was necessary, and although the Duke of Argyll, then Secretary of State for India, had written—Under Despatch P. W. No 119, dated 30th November 1869:—

"It cannot fail to conduce to better harmony between the Military and Civil branches of the Establishment, if whatever advantages are accorded to the members of one, on first entry, should be obtained by both." \* \* "I would further wish you to consider whether there ought not to be only one scale of salaries and allowances for all members of the service both Civil and Military"—It was decided rather than grant this equality, to establish the Royal Indian Engineering College, Cooper's Hill. The reasons which led to this fresh departure are involved in mystery, unless referred to the existence of a clique who would do anything rather than risk the invasion of their peculiar privileges by granting the promised equality to the Civilians.

The Viceroy in Council was against the proposed change. In Despatch 43, dated 28th March 1870, Fort William, Lord Mayo wrote in answer to proposals from the India Office:—

5. And, in the first place, we feel it incumbent on us to record our strong sense of the inexpediency of adopting any measures that shall lead to the creation of a fresh close service for India. We feel that the tendency of the present scheme, when viewed in the light of the remarks made at the end of the second paragraph of your Grace's letter under reply, would almost necessarily be in this direction, even though it be provided that, "under special circumstances," Engineers may be appointed from other sources.

7. The experience of the past few years has shewn that any estimate of future requirements of Engineers for India must be of the vaguest, and most probably of a very fallacious character, and on whatever scale, considered commensurate with present or immediately prospective requirements, a college might now be started, it might very possibly be found that, in a few years, the demand for Engineers had so increased that it could not be met by any expansion of the college which might be immediately practicable. This alone is a strong argument against the assertion of any such principle as that which seems to be enunciated in the 2nd paragraph of your Grace's Despatch.

But we are much inclined to think that if this increase of salary to £420 on first appointment instead of £200 as given to the Stanley Engineers were now offered, it would have a marked effect on the supply of candidates under the existing system, and might possibly remove all the difficulties that have hitherto been experienced in recruiting the Department. We leave it to your Grace to determine whether such an experiment might properly be made before opening the proposed College.

With reference to paragraph 4 of your Grace's Despatch under reply, we may remark that we have already recommended the equalisation of the pay of the Military and Civil branches of the Department, and we are gratified to find this proof that Her Majesty's Government are likely to receive that proposal favorably. On this point we only add that we shall be glad to see some plan adopted by which the furlough allowances of Civil Engineer shall be equalised with those of military officers in the Public Works Department, and so far as practicable, their advantages of pension also.

The profession at home was against it. On the project becoming known the Institute of Civil Engineers took it up and wrote Minutes Proc. Vol. XXXIII. App. :—

"In reference to the alleged failure to obtain the requisite number of competent Civil Engineers for India, the President and Council submit that it may be attributed, in the first instance, to the inadequacy of the emolument hitherto offered; and, secondly, to the conditions of the service, which are less favorable than in some other Departments of the Government, having been established, as the President and Council are informed, on the basis assigned to Native as distinguished from European officials. The first of these impediments will be removed by the promised increase of remuneration; and, if the Government carry out more widely the improvements in the Rules of the Service, which have been commenced, it is the opinion of the President and Council that there will not be any difficulty in supplying Engineers for India from existing sources, without establishing a special Government College—the result of which must inevitably lead to the creation of an injurious monopoly.

"Signed, on behalf of the Council,

"CHARLES B. VIGNOLES,

"President.

(A true Copy.)

"JAMES FORREST,

"Secretary."

"March 18, 1871."



There was therefore some secret influence at work which, in spite of the orders of the Secretary of State, in spite of the willingness of the Viceroy in Council, interposed with official impossibilities and delayed the inception of any Re-organization Scheme which would have the effect of equalizing the Civil and the Royal Engineers in their pay, promotion and emoluments generally, and thus re-establishing recruitment out from the ranks of the Profession at home. The Cooper's Hill College was started, under the Presidentship of a distinguished R. E. for whom a berth was thus found, and the India Office now appealed for recruits not so much to the profession, but rather to the public schools. It industriously spread the idea that a brilliant career as a Civil Engineer in India awaited him who preferred mathematics and the sciences to classics by the new roadway of Cooper's Hill. The career opened up by Woolwich and Chatham was an unknown quantity, and it could not be definitely foreseen in which part of the world it would be spent and in what capacity; the Cooper's Hill career was at least in some degree definite, and this certainty itself was an attraction. The India Office scattered lists shewing the pay of the various classes and grades, and gave the rate of annual payment to allow a comparison in pounds sterling (for it declared that "Rs. 10 = about £1") with the English rate of income; it circulated a statement which shewed the pay and careers of members of the Department who had joined within the previous few years; and it offered the rank on appointment of one grade above that to which Civil Engineers had till now been appointed, with a pay, as it declared, of "about £420 a year." The public schools for a few years responded to the call, and for a while 200 to 300 competitors to enter the College appeared annually. The successful candidates entered Cooper's Hill full of hope and expectation, only to find in after years their Indian career to be full of disappointment and regret. The past careers of Stanley Engineers—which were insufficiently alluring to the profession at home twenty years ago, even when the rupee was worth two shillings—were held up to induce the present Cooper's Hill Engineers to come out to India.

Senior Cooper's Hill men allege that a further table was given them "for guidance" shewing that in the past, promotions had been made from grade to grade at about 2½ year intervals, from which they drew the inference that an average man might expect to obtain a salary of about £1,000 a year for the last 12 years of a 25 year service, supposing him not to reach the Superintending Class—as shewn in the table below.

#### PROSPECTS OF THE CIVIL ENGINEER.

##### A.

*As held out by Government of India, in 1870.*

GRADE.	Years of age.	Years of grade.	Total Salary in 3 year Periods.
Assistant Engineer, 2nd grade ...	23	3	Rs. 12,600
Assistant Engineer, 1st grade ...	26	2	17,400
Executive Engineer, 4th grade ...	28	1	
Executive Engineer, 3rd grade ...	29	3	23,400
Executive Engineer, 2nd grade ...	32	4	28,800
Executive Engineer, 1st grade ...	36	12	32,400
			34,200
			34,200
			34,200

and then retire on a pension of about £400 a year, taking ten rupees as "about equivalent to £1"—which with average savings from the above pay would give about £600 a year.

Meanwhile, pending the arrival in India of the first batch of 50 Civil Engineers from Cooper's Hill—an event which could not take place till the year 1874, as the College course extended over three years—the Indian Government was in the greatest straits in the matter of the supply of European Civil Engineers for the Public Works Department. The supply of "Stanley Engineers" had practically failed altogether, as the numbers of qualified candidates in the years 1870 and 1871 were quite insufficient for the requirements of the service. At its wits' end in this emergency, and actuated by one of those spasmodic bursts of energy that periodically characterise its administration in the matter of the development of public works, the Government of India thereupon engaged in India, and crowded into the Department, within a short space of time, a large number of Engineers from all sources.

It was not long before the earlier arrivals in India from Cooper's Hill discovered that, as a body, they would suffer from a block in promotion quite unparalleled in the history of the Department, and that their chances of ever rising into the higher posts of the service were small in the extreme. Thus, though

the Cooper's Hill Engineers, on first entering the service, received higher pay than the Civil Engineers who preceded them, they soon found that in reality they were far worse off than any other class of officers in the service.

Added to this, the Cooper's Hill Engineers speedily found out that they, in common with all other Civil Engineers, were subjected, by the military administrators of the Department, to the same grievances as had formerly caused serious and general complaint among the Civil Engineers of the Public Works Department. The real state of things that awaited the Cooper's Hill Engineers naturally caused the keenest and bitterest disappointment among them. Utterly disheartened at the hopelessness of their prospects, such of them as could afford to begin life over again resigned the service at an early period of their career, while those who remained speedily united with their seniors among the Civil Engineers in pressing for an amelioration of their grievances at the hands of Government.

VERITAS.

#### CONDITIONS AND SPECIFICATIONS.

SIR,—On the above subject there are very few works to guide the Engineer, although the drawing up of the same is a most important part of his professional duties. It is seldom you see a specification through which the proverbial "coach and four" might not easily be walked through, and I have noted that in nearly every case in which the Engineer and Contractor have entered a Court of Law to settle disputed points, the Contractor has invariably won the case. Nor is this to be wondered at, when we recollect that hardly 5 per cent. of the Engineers in India have practised at home, where of necessity the Engineer is compelled to pay attention to this most important subject.

Of course in India for the ordinary Mistri Contractor no such things as specification of conditions of contract are required. But there is ample scope here for a class of contractors such as one finds in England and who would take over all ordinary works, and save the Engineer a great deal of the worry and bother which are now part of his calling, besides, in a great measure, abolishing that curse of the country—"black mail."

That rates would have to be increased no one will deny, but that increase would be more than met by the decrease in the cost of supervision, which in many cases is as high as 30 per cent.

October 25, 1888.

G. C.

#### P. W. D. UPPER SUBORDINATE PROMOTIONS.

SIR,—I need hardly say that it would have given me no little pleasure to have answered in the affirmative your query, "Is this true?" in regard to the observation of a contemporary that Sub-Engineers rise to second and first grades after fifteen and nineteen years. Some eight or ten years ago the stagnation in promotion was so great that means had to be devised to remove it, the consequence being that some men reached the higher grades within a reasonable time. The remedy, however, was but partial. Look at this province (N.-W. P. and Oudh) for instance. Several in the lower grade have been in that grade for seven years or more, and assuming that those in the higher grades will live to the age of fifty-five, another step of promotion cannot take place for another seven years. Fourteen years without a step of promotion is a lively state of things, is it not? There is still a livelier prospect. The fifty-five years' rule may or may not be enforced. Indeed, I understand we have one ancient in the first grade already. Well, if the rule be not enforced a step of promotion may take place after some nineteen or twenty years! How does your contemporary's observation fit in with these facts? Instead of reading fifteen and nineteen years, twenty-five and thirty-five would be nearer the mark.

Are these men deserving of more consideration? A glance at the Civil List will shew that most of them, and others in the Supervisor grades, are holding important charges. One charge cost Government four or five years ago Rs. 1,400 per mensem, it now is being managed for less than one-third of that sum. As late as last year it was costing Rs. 1,100. So with many others. Some of the charges may not be administered as well now as formerly, but I think the reverse will also bear examination. At any rate, the saving to Government is very considerable, and those who make it possible do not ask much, when they ask attention to the state of things as outlined above. The incremental system, as adopted in the Customs Department and in the Accounts Branch of our own department, seems to be the only remedy possible.

SUB-ENGINEER.

#### IRRIGATION IN THE PUNJAB.

##### III.

##### INUNDATION CANALS.

SIR,—I beg to send you the following remarks in continuation of those already published on the subject in your valuable Journal.

*Upper Sutlej Inundation Canals.*—These consist of the Kutturu, the Khanwah and Upper Sohag Canals, and take out from the Sutlej, nearly opposite Ferozepore. The principal of the series are the Khanwah and Upper Sohag. The Kutturu is almost a new canal, having been constructed by the British Government, and



was initiated by the late Colonel J. C. Anderson, R.E. (Madras Corps), who was the first Superintendent of Inundation Canals in the Punjab after annexation.

There is or should be, in the Punjab Secretariat Irrigation Branch, a magnificent project for a weir across the Sutlej at Hurraku, from 3 to 5 miles long, the cost of which was so great as to have been considered prohibitory in those old conservative days.

The volume of the Sutlej is now, however, so considerably diminished by the Sirhind Canal, that this splendid project might again be taken up and the work (which would now probably not be over one half the original length) carried out and thus convert the Upper Sutlej system of Inundation Canals into a magnificent system of perennial canals. It is hoped this view of this most important work may be adopted by the present Lieutenant-Governor and Chief Engineer.

The Kutturu Canal might, by this means, be easily and profitably extended to Montgomery, and unite with the Bari Doab system, and thus irrigate the whole of the Bari Doab.

The Capital expenditure on the Upper Sutlej Canals amounted at the close of the year 1886-87 to Rs. 5,77,251, there having been no expenditure from Capital during the year.

The working expenses were ...	...	Rs. 1,50,483
The earnings amounted to ...	...	" 1,31,127

Being a loss of 3.35 per cent ...	...	Rs. 19,356
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Whereas, there was a profit of 2.35 in the previous year. The loss is entirely due to the rather heavy expenditure on works, during the year which has all been charged to revenue, whereas Rs. 4,991 expended on extensions and improvements was fairly chargeable to Capital. Maintenance and repair cost Rs. 80,759, being nearly double the amount of the previous year. Good work, however, was done for this expenditure; a new cut for increasing the supply for the Khanwah Canal, improving and widening the upper portion of the Sohag Canal, extensive repairs to the Rajbuhars of the Kutturu Canal.

As the canals are in operation from April to September, the duty per cubic foot of water is in consequence low, having been only 87 acres in 1883-84, the highest in five years.

The proportion of "Flow" to "Lift" is very favorable on these canals, having been, during 1882-83, "Flow" 94.00, "Lift" 6.00, and during 1886-87 "Flow" 89.8, "Lift" 10.2.

The estimated value of the crops irrigated during the year by these canals was Rs. 26,09,626 against Rs. 16,17,263 in the previous year. There is, therefore, a steady development of irrigation on these canals, which would be enormously increased by the construction of the weir at Hurraku, as previously noticed. Possibly, a more suitable site for the weir would now be below the head of the Lower Sohag Canal, and thus head up the water for the entire system of the Upper Sutlej Canals, including the Lower Sohag. All these canals take out from the right bank of the Sutlej. There is also a series of canals taking out from the left bank in the Ferozepore District which would also benefit by the construction of the weir below the Lower Sohag; whereas, if constructed at Hurraku the supply for the Lower Sohag and Ferozepore Canals would be cut off, a result to be avoided.

**Lower Sutlej and Chenab Inundation Canal System.**—This system comprises 19 canals, taking out from the right bank of the Sutlej, and 13 taking out from the left bank of the Chenab, near its confluence with the Sutlej, and irrigate for six months in the year (April to September) the lower portion of the Bari Doab; the old bed of the Beas preventing the complete union of these canals. There was a project contemplated in 1870 for utilizing this old bed of the Beas for the extension of the Bari Doab Canal, but this apparently has fallen through. Possibly, a canal carried down this old channel would be too low for any but "Lift" irrigation.

There was no Capital expenditure on the Lower Sutlej and Chenab Canals during the year, and the total amount of capital expended on these canals to the close of 1886-87 was only Rs. 1,10,102, while the earnings amounted to ... Rs. 6,08,388. The working expenses being ... " 3,92,871.

Leaving a profit of 195.74 ...	...	" 2,16,517
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The profits on these canals during the four preceding years has been 208.74, 199.45, 159.20 and 145.37 per cent. on the Capital expenditure. These high returns are due to the fact that these are all old native canals on which the British Government has expended apparently only Rs. 1,10,102 since the annexation of the Province in April 1849, just 38 years ago.

There is an unrighteous fund on these canals called the "Zarnaga fund" which falls entirely on the poorest cultivator. The system is this; no water rate is charged for irrigation, but instead, every village irrigating from the canals is assessed in a certain number of able-bodied coolies for silt clearance of the canals yearly, a number of temporary moonshees are employed to keep an account of the coolies so furnished by the villages. An influential and fairly rich villager pays one of these coolies some Rs. 5.10 or even Rs. 20, and is let off with 4 or 5 coolies instead of 10, 15 or 20, and the poor cultivator who cannot afford to pay "black mail" to the moonshee has the big man's absentee coolies written against him, for every one of which he is fined 8 annas per day, although the market value of the coolie's work is just half of this, or 4 annas

per day. Thus this iniquitous "Zarnaga," or absentee fund, accumulates year by year. This system should, therefore, be altogether abolished at the next settlement of the district. This system was handed over by Moolraj, to him by his father, under whose administration of the district it is understood the canals were constructed.

There is certain to be opposition, by the very men chiefly affected, to the abolition of this most iniquitous tax. Nevertheless, abolished it should be, and thus a great blot in our otherwise just and lenient administration wiped out. The writer knows the district well, and has the above facts from the cultivators themselves.

The last settlement was effected about 1876, and is for a period of 30 years. Consequently, there is still a period of 18 years of the present settlement to run, thus affording ample time to fully discuss and explain the case to the cultivators. This must be accomplished by the Deputy Commissioner on his cold weather tour in the district, whose communications should be with the poorest cultivators direct, and not through the medium of the tahsildars and their subordinates.

The amounts standing at the credit of these canals is not stated, but 195.74 per centum on the paltry expenditure of Rs. 1,10,102 indicates a very large sum, which surely might be very fitly expended on "Improvements and Extensions" for which very careful and elaborate surveys were made about 1876 by Mr. H. G. Hanna, but nothing further appears to have been done in this direction, and but for General Brownlow, R.E., having been Superintendent of this Circle, about the time these surveys were initiated, probably nothing whatever would have been done in the matter. The present Superintending Engineer of the Derajat Circle, it is believed, has outlived his usefulness (if indeed he ever possessed any) and the permanent Superintendent of the Sirhind Canal, or the Superintending Engineer of the Bari Doab Circle would be much abler and altogether fitter men for the Derajat Circle, than the present incumbent, whose service for a full pension is, or almost is, complete. In fact the very best men of the Departments, Administrative and Executive, should be appointed to the "Inundation Canals" instead of the present system of transferring the seniors of the Department just to put in their time for pensions in easy billets. General Brownlow, had he remained a short time longer, would have changed the whole obsolete system, and as the present Chief Engineer is both young and active, he could not possibly spend his cold weather tour to more advantage than in a close inspection of the Punjab "Inundation Canals," and thus see and judge for himself the capabilities of these canals and their susceptibility of improvement and extension.

The estimated value of the crops irrigated by these canals amounted to Rs. 80,32,618 against Rs. 74,82,409 in the year previous.

**Lower Sohag and Para Canal.**—This canal has always been previously included in the Upper Sutlej system of Inundation Canals, but has recently been separated therefrom.

The Capital expenditure on this canal at the close of 1886-87			
Amounted to ...	...	Rs. 5,59,754	
The earnings to ...	...	" 18,782	
The working expenses to ...	...	" 13,008	

Leaving a profit of ...	...	Rs. 5,774
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Being 1.03 per cent. on the Capital expenditure.

A number of colonists have settled down on this canal, whose demands for irrigation will rapidly develop this new canal.

The proportion of "Lift" to "Flow" irrigation is very high, so far, on this canal, having been "Flow" 78.30, "Lift" 21.70. There is evidently room for considerable improvement in this direction, which it is hoped may be effected as irrigation increases, and the benefits of "Flow" irrigation thoroughly appreciated.

The estimated value of the crops raised by irrigation from this canal, were Rs. 4,54,217 against Rs. 2,83,813, in the previous year, which conclusively proves that the canal is appreciated by the cultivators.

**Indus Inundation Canals.**—These consist of great number of canals taking out from the right bank of the Indus on the very border of the Dehra Ismail Khan District, and extending as far down as Mithenkote, the confluence of the historical five rivers of the Punjab.

The Capital expenditure on these canals at the close of 1886-87			
Amounted to ...	...	Rs. 7,09,983	
The working expenses to ...	...	" 2,49,040	
And the earnings to ...	...	" 2,43,001	

Being a loss of 0.85 ...	...	Rs. 6,039
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The proportion of "Lift" to "Flow" is rather low on these canals during the year, having been "Flow" 88.27, "Lift" 11.73. The area irrigated by the canals was 178,671 acres, and the estimated value of the produce raised was Rs. 46,76,245 against Rs. 52,04,923 in the year previous.



## IRON TRADE PROSPECTS.

SIR,—From the Journal of the Royal Statistical Society for March 1888 I gather that, at the beginning of the year, a great stimulus was given to English iron and steel markets, in consequence of large orders from the United States, where capacity for production failed to meet the needs of the country. It is too soon yet to prophesy failure to the predominance of United States markets. But the time is coming, the times are working up to it. No country's resources—not even the most typically golden colored of Golcondas could prevail against such reckless suicidal improvidence as is apparent to any one, having eyes to see, in the inner working of affairs in the United States Government. A few years ago Colonel Fiske made a shining hotel fight against financial difficulties, and he was a type and exemplar of his countrymen's day and generation, and will continue to be, probably, till the moon takes a new cyclical turn.

Pending whatever cataclysm is impendent, could not English iron and steel workmen transfer predominance in their special trades from the States to England. Could not Indian workmen cut both out, and by dint of cheap working, accuracy of detail, careful finish, and so forth get a hold on the market, leading up to something like an English monopoly? The affair, of course, could not be arranged in a day, or a week—a year even. But, it might nevertheless be worth while to begin thinking about it.

It pleases one to find energetic protest entered in this writing against the wholesale mania of the commercial world of late years for joint stock companies. Their advantages—on paper—are so sedulously set forth, in every paper printed in the country, that any attempt at recapitulation of the subject would needs prove offensive. Reference to it is, however, necessary in connection with the matter I am presently engaged with. In that connection the following extract is valuable :—

"Both as regards the past year and with respect to the future, account will have to be taken of the change which has taken place in the manner of conducting business. The old form of personal contact between traders and their *employés* and customers is fast disappearing, and in place of it we have the impersonal form of limited liability companies to deal with. Much mischief has arisen, and will probably continue to be experienced from this change. When a trader embarks his own resources, and finds that in place of making a profit he is losing money, he curtails his commitments; but when a limited-liability company is in a similar position, it as often as not extends its works with borrowed capital, and endeavours by increased production to overcome the effect of smaller percentage profits, if, indeed, it does not actually continue to carry on increased production at a loss, under the impression that it will be able to crush out the competition of other joint stock companies and private producers having smaller resources to work with. Such a change in the condition of doing business may, unless a check is imposed on indiscriminate company promotion, work mischief, and be aggravated by the circumstance of large capital being created with a fixed yearly charge irrespective of whether the company makes a profit or not."

The substitution of telephones for telegraphs on Railway lines and elsewhere in America is held to have resulted equally in increase of efficiency and economy.

FAIR TRADE.

## Literary Notices.

ART-MANUFACTURES OF INDIA, SPECIALLY COMPILED FOR THE GLASGOW INTERNATIONAL EXHIBITION, 1888. By T. N. Mukharji, F.L.S., Indian Museum, Calcutta.

THIS Catalogue, or Guide-book, or whatever it ought to be called, represents a great deal of painstaking and intelligent research on a great many interesting subjects—history, ethnology, archæology, folklore, etc., arising out of, dovetailing into, the matter of India's Art-Manufactures—a matter we are glad to find specially to the fore just now. With reference to pictorial art our author thinks that perhaps—thanks to the good work done by Government Schools of Art—we are on the eve of a renaissance of painting, of the Ajanta cave-temple type. God forbid! Indian art students should learn to draw before they essay ambitious paintings. There is quite enough high falutin knocking about as it is—in Art as in College degrees. What the country wants, what it is urgently in need of is practicality. *Apropos*, porcelain Hindoo gods are now being imported from England.

Manufactures in metal, in brass especially, are the most important of Indian art wares. Cooking and other household

utensils are, to a great extent, made of brass. Brass is difficult to keep clean and sheeny however, and so it happens that *kānsā*, or *phul*, a form of bell-metal composed of four parts of copper to one of tin is much in favor; extensively used in the manufacture of plates, cups, and drinking glasses. Indian goldsmiths especially excel in the manufacture of gold and silver filagree work. The Maharajah of Jeypore has in his employ an artisan from Ulwar named Nand Kishore, who received his education at the Government Engineering College at Roorkee. He has introduced in the working of gold and silver plate a new style of surface decoration, *viz.*, of engraving figures on the plate in such a way as to imitate in metal the clothing of human beings, the natural fur of animals, the feathers of birds, and so forth. Given adequate incentives, and even the phlegmatic Hindoo is not uniuventive—especially when he has been educated at Roorkee. The Burmese silver work, so well thought of by connoisseurs is being improved under the guidance of Europeans, who are careful, we rejoice to hear, to preserve the national characteristics.

Burmese *niello* work is famous. Damascened or *kofigari* work flourishes at Gujrat and Kotli Loharan near Sealkote. It is also practised at Lahore, Jeypore, Karauli, Ulwar, Datia, &c.

With the extension of Railways, and facilities for inter-communication, English wares are pushing many native manufactures beyond the range of profitable production—*e. g.*, cutlery, brassware, earthenware, Brummagem jewellery, patent leather shoes, silk and cotton fabrics. With reference to the latter Mr. Mukharji writes :—"The wonder is that cotton fabrics can still be manufactured with the old primitive loom all over the country. In one sense it is a misfortune that it should be so, for it shews the low value of human labor in India. Machinery, with all its modern improvements, seems to contend in vain with a moribund industry that must linger on as long as the worker in it has nothing better to do than to produce from it fourpence a day as the joint earnings of himself, his wife, a boy, and a girl. Those that wield the machinery should lay their heads together, and devise means to teach the people how better to employ their hands in other crafts." Side winds in favor of technical education in India are constantly springing up. It is said that two hundred years ago a piece of Dacca muslin, fifteen yards long by one yard wide, could be manufactured so fine as to weigh only 900 grains.

It is safe to say a good many things about 200 years ago especially in India. But there can be no doubt about the falling off in Dacca muslins.

Only—was it worth while, would it be worth while now, to pay £40 for fifteen yards of gossamer? That was the price charged for fairylike texture. Muslins of more useful quality are still manufactured at Jahanabad, Lucknow, Benares, Rampore, and all over the Eastern Districts of Bengal. Cotton cloths of different kinds are woven at Moradabad, Pratabgarh, Cawnpore, Lalitpur, in the Azimgarh and Meerut districts, &c. Agra turns out large quantities of check and striped cotton cloths. The wage earned by a workman is—"about two annas a day." And yet the average profit is only some 3 per cent. In Assam even (where spinning and weaving are done at home) English yarn is rapidly taking the place of home-spun thread, except when coarse and particularly durable cloths are required. Specious flimsiness appears to be the rock Manchester is likely to split upon, unless mill-owners there take warning in time.

For clothing material cotton stuffs are greatly preferred to woollen stuffs by the people of India, even in cold weather. Coats padded with cotton wool are worn by the well-to-do at that season. The climate is opposed to the good preservation of woollen stuffs; and "in the opinion of the people no amount of thick wool can be as warm as quilted cotton."

Mr. Mukharji's book contains chapters on dyeing on embroidery, and on carpets.

A capital book, and worthy of commendation.



## General Articles.

### P. W. D. OFFICE, BOMBAY.

THE drawing which we now give as the first of a series of illustrations of the public buildings in Bombay represents a very handsome Venetian Gothic building, having for a site the southern side of the continuation of Church Gate Street opposite the Post Office, facing north, extending from the Esplanade Main Road to the Wellington Road, and at right angles to the frontage formed by the Secretariat, University Buildings and High Court.

This building was erected from designs by Colonel H. St. Clair Wilkins, R.E., A.-D.-C. to the Queen, and sanctioned by the Government of India, on the 4th May 1869, the work being commenced on the 21st May of the same year, and completed on the 1st April 1872. The work was carried out under the immediate orders of Lieutenant-Colonel J. A. Fuller, R.E., from May 1869 to May 1871, Mr. J. H. E. Hart, M. Inst. C. E., from May 1871 to April 1872, Mr. Wasudew Bapujee Kanitkar, being Assistant Engineer in charge.

The building is 288½ feet in length, 50½ feet in breadth and consists of a basement, two storeys over all, and a third storey over the centre portion forming a handsome and commanding architectural feature. The height to the eaves generally is 54 feet, and in the centre 82 feet, the highest point of the roof being 116 feet. The building contains 916,700 cubic feet, and it is faced with hammer-dressed coursed blue basalt rubble in courses not deeper than 5 inches with bands in Coorla rubble; the dressings of Porebunder stone; with red and blue basalt alternating with Porebunder stone, in the arches. The distribution of rooms is as follows:—

#### GROUND FLOOR.

- No. 1. Superintending Engineering at the Presidency.
- No. 2. Architectural Executive Engineer and Surveyor.
- No. 3. Executive Engineer at the Presidency.

#### FIRST FLOOR.

- No. 1. Examiner of P. W. Accounts.

#### SECOND FLOOR.

- No. 1. Secretary to Government, Public Works and Railway Departments.
- No. 2. Consulting Engineer for Railways.
- No. 3. Examiner of Railway Accounts.

The actual cost was Rs. 4,14,484.

XENOPHON.

## BICYCLE RUNNING.

BY A. EW BANK.

### VI.

A FEW years ago mechanics used the word strains rather loosely. Sometimes the word meant distortions of figure and sometimes the forces that produced these distortions. In late years careful writers speak of strains for distortions of figures or any alteration of size or shape while the accompanying forces are always called stresses.

Thus we have learned that if a bicyclist applies, or attempts to apply, a  $\beta$ -rotation he causes stresses through the connections. These stresses, together with the additional ground friction on the hind wheel, will account for any reactive movement which the bicyclist unintentionally causes in the bicycle *minus* its front wheel. The stresses must be there, but the ground frictions may prevent any new movement.

To illustrate this point let us return to the cord suspended bicycle with its rider. Let G be the C G of the whole mass. Let the cords be fixed to the bicycle at points A, B—say in the same level. Let the cords be A H and B K. Let G lie midway between them. Then these cords have equal tensions. The bicycle *plus* rider may be replaced by a uniform metal body A B as long as the rider is passive. If the rider is active and tries a  $\beta$ -twist it is as if one part of A B acted on another part.

Let the rider give a  $\beta$ -twist. Then the actions and reactions called into play being equal and opposite cannot in any way move G. If we look at the cords we see that they are no longer parallel. Let their tensions be T and T when the rider by forcibly causing a twist has somewhat raised himself temporarily. One T is equivalent to a vertical force V and a horizontal force R. The other T gives the same vertical force V, but a horizontal force exactly opposite to R. It is these vertical forces V, V that are responsible for the lift of G. Let W be the total weight of rider and machine. Thus 2 V was momentarily greater than W while the  $\beta$ -twist was being effected.

There being no resultant horizontal force G had no horizontal displacement. The  $\beta$ -twist moves the front wheel about a vertical axis through its centre. This has no tendency to move its C G. And the C G of the whole has not moved. Therefore the C G of the rest of the mass—*viz.* rider *plus* bicycle *minus* front wheel—has no tendency to move. If then this remaining mass moves at all it must rotate about an axis through its own centre of gravity. This reasoning deals only with the horizontal movements. The vertical lift is not here considered.

Similarly, let a bicyclist with his bicycle running upright endeavour to give a  $\beta$ -twist. This does not shift the C G of the front wheel either right or left of the track. The C G of the whole mass cannot be moved by the mere actions *plus* reactions involved in effecting the twist. Therefore, the reactions considered by themselves have no tendency to shift the C G of the total mass *minus* the front wheel mass. Therefore, this remaining mass tends to rotate about a vertical axis through its own C G. Such a motion would carry the hind wheel sideways out of its momentary track. The resistance of the ground to such a broadside movement may be great. The hind wheel therefore may not take this broadside movement. The opposite ground force being an external force is a force on the whole machine *plus* its rider. If the  $\beta$ -twist was clockwise the hind wheel was endeavouring to deflect to the right by having a rotation counter-clockwise about a point in front of it. The frictional resistance is therefore leftwards. If the bicycle is running due west this frictional force is southwards. There are also the new frictions at the base of the front wheel, and due to the real or attempted  $\beta$ . We may consider them to amount to a counter-clockwise couple. It will be remembered that the bicycle was upright. These forces on the front wheel therefore tend to cause no linear velocity in the C G of the whole mass. Thus the frictional force at the hind wheel is the only external force—as contrasted with a couple—to consider. The force on the hind wheel lasts as long as the hind wheel tries to move broadside on to the right or the north. If the hind wheel began to shift to the south, the friction would immediately change in direction. We see, therefore, that if a bicyclist gives a clockwise  $\beta$ -twist he causes stresses throughout the machine, and also that a ground friction on the hind wheel may be acting sideways though the hind wheel keeps its track. The bicyclist travelling westwards, and attempting a clockwise  $\beta$ -rotation, this frictional force  $F_1$  acts towards the south.

Let a wheel or bicycle be placed, at rest and at a slope  $\theta$  on a level smooth plane. The C G tends to descend vertically—the wheel or wheels slipping. If the ground is rough, the slipping is prevented, and hence a *new* force  $F_2$  acts towards the south if the bicycle was directed towards the west. Now suppose that a bicyclist, who is travelling at a left slope towards the west, suddenly puts the drag on. The machine has a certain tendency to fall. Hence a friction  $F_2$  acts towards the south independent of the drag friction which acts east. Again the bicycle, as a whole, when travelling, is bearing constantly towards the left. The only force which can produce this must be such a force as  $F_2$ . Hence if the bicyclist suddenly attempts a clockwise  $\beta$ -rotation we have a certain force  $F_1 + F_2$  directed southwards besides any frictions along the track.

It may sometimes happen that—the ground being changed every moment—the wheels run into ground





"Photo-Tint" by James Ackerman. Queen Square London W. 2



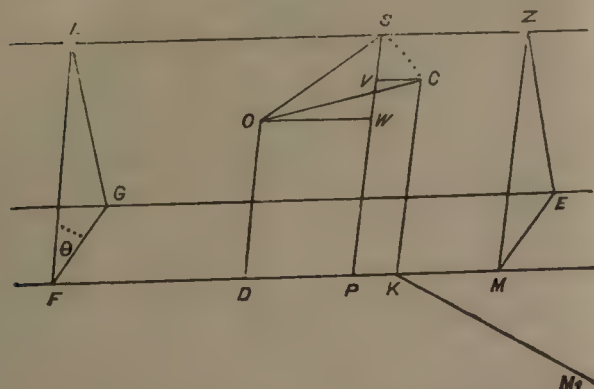




that cannot provide  $F_1 + F_2$ , or perhaps even  $F_2$  alone. In such a case the hind wheel may slip. Such slippings, in fact, do occasionally occur when the bicycle is on a slope, and consequently on a curving track.

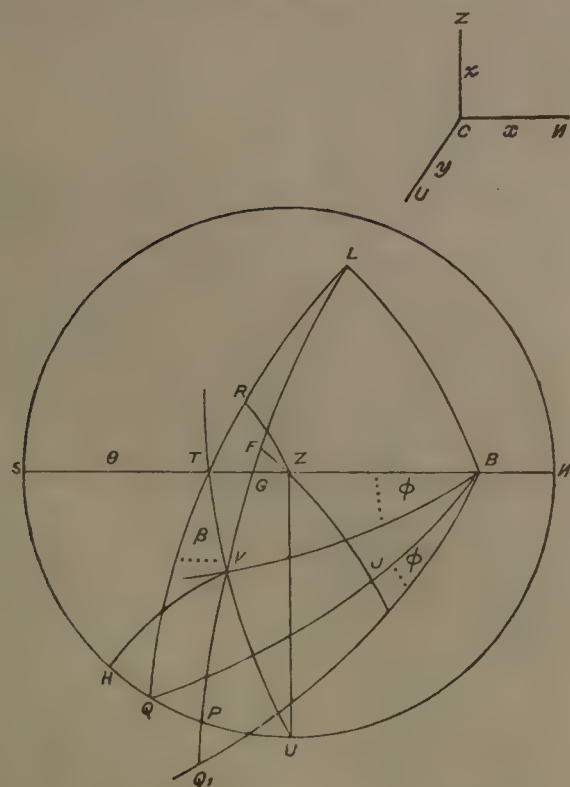
We may now take up the consideration of what we called the "simplest" solution. We have to lift the front wheel sufficiently to have all its mass above ground.

Fig. 6.



In fig. 6 the reader may be supposed to be standing on the line DF produced. He is behind a bicycle whose front wheel centre is C and hind wheel centre O. The bicycle is heeled over in the plane LFMZ, and GFME is the horizontal ground. The front wheel has had a  $\beta$ -rotation, and thus the momentary front wheel track is changed from KM to  $KM_1$ , as was the case in fig. 5. The angle  $MKM_1$ , which in fig. 5 was equal to  $\angle ECQ$ , we denote by the Greek letter  $\sigma$ . This letter carelessly written is apt to be mistaken for the figure 6.

Fig. 5.



The front wheel by changing its plane from CKM to CKM<sup>1</sup> buries its lowest point in the ground. When the  $\beta$ -rotation has been effected, this rotation is to be left undisturbed. The front wheel and the connections are now to revolve as one rigid body about a normal drawn through O to the hind wheel plane, which plane, approximately, is the plane LFMZ. The rotation about this normal may be thus defined. This normal (drawn so as to slope upwards) slopes to the right hand as seen from a point in DF produced. Let the line so drawn be OI, where the letter I is not shewn in the figure. Let a man

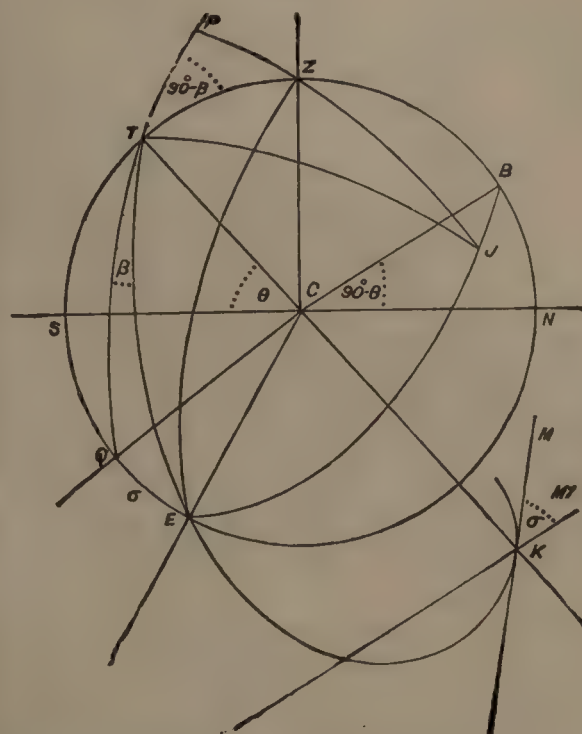
stand with his feet at O and his body along OI. Then the necessary rotation to lift the front wheel will, to him, be counter-clockwise.

We shall call this a  $\phi$ -rotation. If we ever have occasion to consider a clockwise rotation about OI, we can give  $\phi$  a negative sign. Similarly if a bicyclist turns his handle in the opposite way to that which we have assumed we can consider  $\beta$  negative.

Now a rotation  $\phi$  if applied to the front wheel in the plane CKM will keep the wheel in this plane. But the  $\phi$ -rotation applied to the real wheel, which is in the plane CKM<sup>1</sup>, will cause the wheel plane to take a third position. This third position involves a third momentary track line. We have to investigate expressions for the final inclination of the wheel plane and for the final momentary track.

In fig. 5 we had a rough perspective representation of certain planes. In fig. 7 we adopt a different presentation of the planes.

Fig. 7.



C is the unseen centre of a sphere, and CZ a vertical radius. On CZ produced the observer is placed, and so to him the point C is hidden by the point Z. Thus C does not appear in the main figure. SNU is a horizontal plane through C. T is the original highest front wheel point as it was in fig. 5. All great circles of the sphere that pass through Z will to the observer, project into straight lines on the plane SNU. All other great circles will project into ellipses on SNU.

The original front wheel plane is TU. This wheel plane revolved about the line CT into the position QT. ZR is drawn perpendicular to QT as in fig. 5. Now this plane QT has to execute a rotation about a certain line through the point O of fig. 6. A rotation about the line OI of fig. 6 is known to be equivalent to an equal rotation about a parallel line drawn through any other point. The equivalence we speak of here refers solely to the new direction of the rotated plane or of any line in that plane. The equivalence does not refer to the new position which involves a movement of translation. But we are at present only studying the final inclination to the horizon of the front wheel plane and the final momentary track. We shall therefore replace the  $\phi$ -rotation about O by an equal  $\phi$ -rotation about that line which we called CB in fig. 5. This line would also be CB in fig. 7 if we could indicate the point C. To a man imagined as having his feet at the centre of our sphere in fig. 7, and his face at B, and looking at T, which is a certain point on the front wheel—but not now the highest point—the  $\phi$ -rotation is counter-clockwise, being



the same in character as the rotation round the hind wheel axis O I of *fig. 6*.

Now B is the pole of T U, and the  $\phi$ -rotation will carry the point T of the wheel along the circle T U to a point V. The point Q of the wheel will be carried below the plane S N U to some point Q<sub>1</sub>.

Thus V and Q<sub>1</sub> are points in the new wheel plane, and these two points are sufficient to determine the plane. The great circle Q<sub>1</sub> V cuts S U in P, and if produced far enough meets Q T produced in I. This point I has no connection with the point I of *fig. 6*. If  $\phi$  were an infinitesimal angle—a question we at present in our mere geometry leave open—we should draw a circle B I perpendicular to Q T, and so determine the place where Q<sub>1</sub> V cuts Q T. The line C P is the new momentary track. The new inclination of the wheel plane is  $90^\circ - \angle Z F$ . The figure shews that the  $\phi$ -rotation has still further increased the angle which the wheel makes with the horizon.

We could calculate the position of the new plane Q<sub>1</sub> V by taking co-ordinate axes C N, C U, C Z as shewn in the small subsidiary figure. But we can calculate the arcs P U and Z F by ordinary spherical trigonometry, and this we shall do in the next paper. We afterwards return to *fig. 6*, in which we have C the front wheel centre describing a small arc C S about O, and thus lifting itself by the vertical difference between the C and S positions.

### THE OYSTER REEF LIGHT-HOUSE.

NOTE BY LIEUTENANT-COLONEL W. G. CUMMING, R.E.,  
*Superintending Engineer, Lower Burma.*

#### II.

16. For this purpose I attach a carefully prepared plan of Oyster Island, shewing its shape and configuration, the reefs by which it is surrounded, the site selected for the new permanent light-house, the site of the existing temporary wooden light-house and its subsidiary buildings erected in 1885-86, the reduced level of high and low water of ordinary spring-tides, and longitudinal and cross sections shewing the respective depths at which the underlying reef of stiff shaley clay is found below ground surface.

17. Three borings, or rather three excavations, were made by the Executive Engineer of the division in the early part of 1886 through the accumulated mass of sand and shell *débris* with the result that a stiff blue clayey shale was everywhere met with at depths varying from 9 to 12 feet below ground level. On the 30th November last I verified the boring taken at the site selected for the new light-house (marked E on the plan) and found the measurements to agree closely with those recorded by the Executive Engineer. The underlying reef was found at a depth of 9 feet 9 inches below ground surface. It was half tide at the time and there was 2½ feet of water over the clay. The Executive Engineer states that, when he took his measurements in 1886, he found 1 foot of water at low tide and 2½ at high tide. Possibly 3 feet would be nearer the mark. This water finds its way in by percolation, the rise and fall of 2 feet corresponding to a rise and fall of 10·30 feet in the surrounding sea. The water was brackish.

18. The boring was continued in January last to ascertain the nature and composition of the underlying strata. An augur and flanged screw were both tried, but without effect. Neither would bite. A chisel was then resorted to. This was jumped down slowly and with considerable difficulty to a depth of 24 feet 3 inches through stiff clay. The boring had now reached a depth of 34 feet below the surface of the island. Specimens of the clay were brought up in a pine and were not found to vary throughout the whole depth of 24½ feet. They were, moreover, found to be similar in all respects to the stiff clayey shale first met with at 9 feet 9 inches below ground level.

19. Foundations of the nature described are, in my opinion, good and suitable. No great difficulty should, therefore, be experienced in constructing the light-house.

Water may give some trouble, but, as it can only percolate into the foundation trench through the loose sand and shale *débris*, a properly constructed coffer-dam and pumps should keep it under.

20. From the nature of the clay I consider that it would not be practicable to screw down piles to any considerable depth. Piles are moreover unnecessary, as the breadth of the base, the weight of the structure, and the concrete filling should be sufficient to overcome any tendency of the building to turn over in a cyclone.

21. As little iron-work as possible should be buried under ground. Cast-iron in light-houses is not objectionable if the light-keepers can get at it to paint it, and so long as the paint brush can be applied there need be no fear of corrosion. This being the case, the cast-iron tower should, I think, commence above the level of the surface of the ground.

22. The nature of the foundations appears to point to a solid block of concrete as most suitable as a base for the tower. In this block at a low level a cast-iron ring should be added connected with the base plate of the tower by a number of bolts, thus adding the weight of the concrete block, or a portion of it, to the weight of the concrete that may be put into the lower part of the tower to ensure stability.

23. As floors add greatly to the strength of an iron light-house, they should, if possible, be not more than 12 feet apart, and although the tower is intended to carry a fixed light, a well, say 2 feet 6 inches in diameter, should be provided to facilitate the carriage of stores to the different floors and to the light-room.

24. When designing the foundations and tower the effect of the wind must be considered. On this point Mr. H. M. Mathews, C.I.E., an officer of large and varied experience in light-house construction, has recorded the following note, dated the 25th June 1886, while officiating as Chief Engineer of this province:—

"Molesworth's pocket-book at page 366 gives the greatest velocity of the wind at 100 miles per hour, but I am convinced that this is greatly under the mark.

"Quite recently when looking through the monthly weather review published by the War Department of the United States, I found that on the 26th February 1836 the wind had continued to blow for eight hours consecutively at Mount Washington, New Hampshire, at the rate of 115·6 miles per hour, the instrument having registered 925 miles.

"It is evident that the rate could not have continued the same throughout, but that it must have blown stronger at times, and therefore I consider that 120 miles per hour is not too high.

"The pressure per foot super =  $\frac{6049 \cdot 2}{100}$ , therefore a velocity of—  
100 miles = 49·200 lbs. per foot,  
and 120 miles = 70·848 lbs. per foot,  
a very considerable increase to the addition to what was considered the highest pressure or that due to a hurricane.

"In my opinion the weight of the structure, including so much of the foundations as form part of the structure and would turn over with it in case of an upset, should be not less than three times the effective force that can be applied by wind."

This I think is a sound opinion. It should be kept carefully in mind when the plans are being prepared for the new light-house.

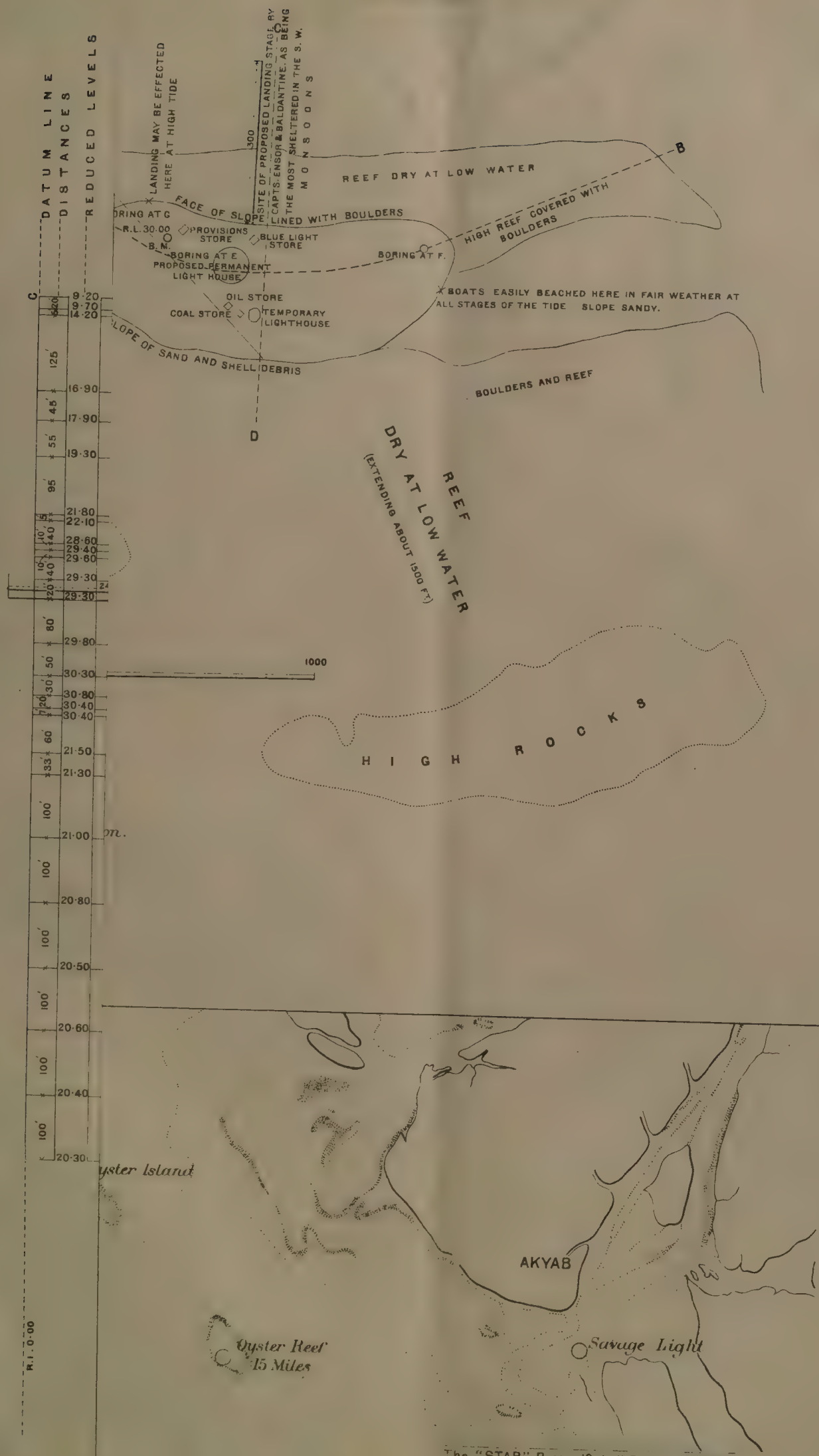
25. As regards materials on the island for concrete and ashlar work, lime there is none except what can be made out of coral *débris*. Portland cement and soorkee should be used for all work below ground level. Ordinary stone lime mixed with soorkee can be used for the remainder. For ashlar work the boulders lying round the island are not suitable, though it is possible that some of them beyond the wash of the sea may be found useful for concrete.

In any case this part of the work will be costly, as most of the materials required will have to be brought from Akyab, 30 miles distant.

26. The information given in this note and its accompaniments will, I trust, be found sufficient to enable specialists in England to design and prepare a structure suitable to our wants. There is no one now in Burma qualified by previous training in light-house construction to satisfactorily undertake the work, though we are prepared to erect the light-house as soon as the plans and the iron-work are received.



Vertical Scale 16 Feet = 1 Inch.









## NOTES FROM HOME.

*(From our own Correspondent.)*

A SCHEME is now on the tapis for a ship canal connecting the Forth with the Clyde which will be available, not only for merchant vessels, but for war ships as well. There is no doubt that such a canal would command a large traffic, and could it be economically constructed, would be a source of revenue to its proprietors. It is most interesting to note how ancient modes of transit re-assert themselves, whilst the Railway system of Great Britain is in the main completed; its ancient competitor, the canal, which for many years was entirely neglected, is now once more receiving a prominent share of attention.

At the last meeting of the Neath and Brecon Railway Company the Chairman, Colonel Laurie, made an announcement which has excited some attention. It appears that for some years past the Midland Railway Company work the through traffic over the Company's line, and their agreement expires with this year. The Chairman stated that it was not the intention of the Directors to renew this agreement, and hinted that Sir Edward Watkin, he hoped, would be induced to more closely associate himself with their line. This statement of the Chairman's is considered to point to future arrangements which would bring the Neath and Brecon Railway in close connection with the Manchester, Sheffield and Lincolnshire Railway, and thus provide that great system which is now a gathering ground for traffic for other Railways, with an independent access to Central Wales and the great shipping ports of Neath and Swansea. It may be interesting to state that Sir Edward Watkin is about to visit India, and will leave England for that purpose on the 15th October.

The last volume of the Proceedings of the Institution (vol. 94) has just been issued. It contains papers on the distribution of hydraulic power in London, and the description of the Tay Viaduct. Both these papers are copiously illustrated, and the discussions which follow are very fully given. The usual good collection of other selected papers then follow, but the volume is chiefly noteworthy from the excellent portrait as a frontispiece and memoir of the late Thomas E. Harrison, the Engineer-in-Chief of the North-Eastern Railway, whose death caused a gap in the rôle of eminent Engineers which will not be easily filled up.

Having had the pleasure of knowing him personally, I can only endorse the concluding words of the memoir which run as follow:—"Thus a great man and a great Engineer has been taken from us, amidst the affectionate regrets of all who knew him. In the circle in which he more immediately moved, a blank has been created which can never be filled up. The memory of his long and distinguished career, of his eminent ability and unsullied reputation, will long survive him; while his numerous important works will tell to future generations of the soundness and skill which devised them, and of the integrity and care with which they were carried out."

The Association of Municipal Engineers lately visited the Vrnwy Works for the supply of water to Liverpool. These important and very extensive works are now approaching completion, and afford to those engaged in water-supply probably the most interesting example of their kind in the kingdom. The masonry dam of the great reservoir is eighty feet in height, and dams up the water to the extent of 5 miles along the course of the stream. The supply to Liverpool is taken from the reservoir at a considerable distance from the dam and is drawn off through iron pipes so constructed and fixed in a tower of masonry, that the water will run off at six feet from the surface. It is here passed through wire screens before passing on to the filter beds at Oswestry. The tunnel is 7' in diameter, and the iron conduit 3' 6" in diameter.

The new Railway line from Wimbledon to Putney which will supply direct communication with the West of London jointly by the London and South-Western Railway and the District Railway Companies, is now nearly completed, and it is expected to be opened next month.

A paper is published this week from Dr. Müller bearing upon the subject of main drainage and sewerage irrigation, more particularly descriptive of the system known as the Berlin system. It appears from this paper that some time ago the sewage farms of Berlin were a public nuisance, so much so that the Government found it necessary to order a survey and to appoint an official supervisor for the works, and from

that date things took a decided turn for the better. Dr. Müller is no advocate for asphalt pavements for streets and courtyards—for he says it cannot be denied that these prevent the self-cleansing process of the ground, permeated as it is in large towns by impurities, and this not merely in spite of the sewerage system, but largely in consequence of it, thus collecting the germs of disease as it were in a Pandora's box on the one hand, and on the other making it impossible to plant the streets and roadways with trees.

The inhabitants of Poplar have been urging upon the Metropolitan Board of Works to proceed without delay in the construction of the Thames Tunnel (Blackwall) making it suitable for vehicular as well as foot traffic.

## MINING IN GREAT BRITAIN.

*(From our own Correspondent.)*

THE noble and disinterested courage with which Clarence Stewart Lindsay did not hesitate to incur danger in the attempt to save the victims of the great disaster at the De Beer's mine, has made him the admiration of Englishmen in all parts of the world. Such an act of heroism and humanity, voluntarily performed, at the risk of life, should be remembered by all Englishmen, and it is a matter of regret that there is no public recognition for conduct as brave as that of any soldier on the field of battle. It is hoped that in this instance some permanent memorial will be created to commemorate such an instance of conspicuous bravery and unselfish courage.

The advocates of State-aided technical education brought two Bills forward this year, both of which were withdrawn after the first reading. These Bills provided for instruction in the use of tools, and modelling in clay and other materials and in the application of the principles of science and art to industries. The cost of such education is to be charged to local rates and administered by local authorities. In most cases, the school board authorities would carry out the provisions of these Bills. It is a matter of regret that such authorities as Sir Henry Roscoe should be so eager to remodel our educational system. Technical schools may be valuable, but the best results would be obtained by improvements of the old apprenticeship system, which has hitherto produced the best mechanics in the world.

Again, we all know how members of school boards are drawn from retired butchers, pastry cooks, publicans and others who are not competent to judge as to the nature of the technical instruction for special industries. The subject of technical education should be welded to the present apprenticeship system by private enterprise, rather than attempts should be made to cram lads of 12 or 13 years of age with the use of tools, instead of instruction in leading principles which would tend to develop their mental, physical and moral faculties.

A Commission appointed by the French Government has demonstrated, by numerous experiments, that explosive substances, ignited in the midst of explosive mixtures of fire-damp and air, can only ignite them when the temperature of explosion exceeds 4,000° Fahrenheit. The Commission has prepared mixtures of explosive substantives, incapable of igniting explosive atmospheres. Their composition is determined in such a manner as ensures their temperature of ignition being less than 4,000. The Commission found, by numerous experiments, that mixtures of dynamite with equal weights of carbonate of soda, sulphate of soda, ammoniacal alum or chlorate of ammonia did not ignite explosive mixtures when exploded in them. The same effects were produced by mixing dynamite with finely pulverised coal dust. The mixtures formed by adding nitrate of ammonia to nitro-glycerines or to guncotton are perhaps the best, as the nitrate acts itself as an explosive, and lowers the temperature of explosion, as its own temperature of explosion is about 2,070°, whilst that of dynamite is 5,220°, that of nitro-glycerine is 5,740°, and that of guncotton is 4,780°.

The North of England Institute of Mining Engineers, in conjunction with the Mining Institutes of South Wales and the Midlands has appointed a representative Committee to report upon questions of mine ventilators. Many new fans have been introduced since the report of the last Committee of the North of England Institute, and mine managers will welcome the report as disposing of the question of the most efficient means of mine ventilation available at the present time.

The Mining Institute of Scotland recently appointed a Committee to experiment with "roburite" with coal shots



Mr N. F. McLeod, Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India five weeks' furlough, in extension of that granted him in Notification, dated 7th April 1887.



With reference to Notification, dated 22nd October 1888, Mr. A. C. Evans, Executive Engineer, is retransferred from the Mainpuri Division to the Etawah Division, Lower Ganges Canal.

#### Central Provinces, October 27, 1888.

Mr. R. B. Thompson, Executive Engineer, reported his departure from Bombay on the 3rd current, on the furlough granted to him by Notification dated the 27th ultimo.

Mr. D. Wallace, Executive Engineer, Eastern Division, is transferred to the Jubbulpore Division.

#### Assam, October 27, 1888.

Mr. W. McM. Sweet, Executive Engineer, 4th grade, temporary rank, Sibsagar, and Manager of the Jorhat State Railway, who was granted privilege leave for three months in Orders, dated 5th June 1888, reported his return to duty on the forenoon of the 19th October 1888, and took over charge of the Sibsagar Division from Mr. D. J. Clancey, Officiating Executive Engineer, on the 22nd idem.

#### Bengal, October 31, 1888.

##### Railway.

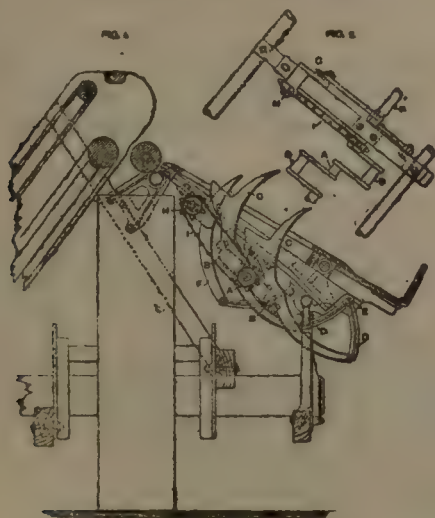
With reference to Government of India, Public Works Department Notification, dated 12th October 1888, Mr. F. V. Taylor, Assistant Engineer, 2nd grade, is posted to the Western Bengal Railway Surveys.

With reference to Government of India, Public Works Department Notification of the 12th October 1888, Mr. P. P. Rogers, Assistant Engineer, 1st grade, is posted to the Eastern Bengal State Railway.

## Indian Engineering Patent Register.

### RECENT BRITISH PATENTS.

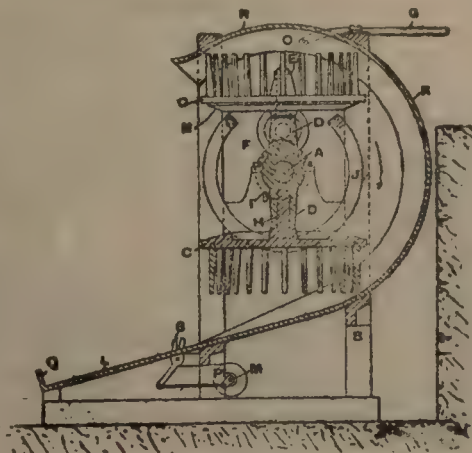
**HARVESTERS.**—*J. Hornsby, J. Innocent, & I. Trolley, Grantham.*—In order to prevent any straw from winding itself upon the spindles of the rollers which operate the various sets of canvasses for conveying the cut crop to the binder platform, the inventors make the rollers longer than has been the case hitherto; the timbers to which the



bearings are fastened are recessed for the reception of the ends of the rollers, and they form a hood for the ends of the rollers. Sometimes, when the machine is cutting a crop with an undergrowth of weeds, the crop passes sluggishly down the binder table, especially at the end of the table where the stubble end of the crop passes down. In order to accelerate the motion of the crop, the inventors have devised several mechanisms, one of which is represented in the accompanying figures. An auxiliary packer F is mounted between the ordinary packer spindle and the elevators. The packers C are carried on the crank arms B, which are mounted on a horizontal axle A, and their ends are pivoted to the swinging arms D, which oscillate about a common centre E. The auxiliary packer F is driven by a crank pin G on the auxiliary shaft H, the latter shaft being driven from the shaft A by means of a pitch chain I and chain wheels as shewn. Seven claims are made for the recess in the framing to receive the ends of the rollers carrying the canvasses used in conveying the cut crop, and for the various arrangements of extra stirrers between the crank axle of the ordinary packers and the top of the binding table for the purpose of passing down the stubble end of the cut crop.—No. 9819. July 13th, 1887.

**REELING MECHANISM FOR ROLLING MILLS.**—*F. H. Daniels, Worcester, Massachusetts.*—The new feature of this invention lies in the arrangement of the reel receptacles. There are more than one of these receptacles, and they receive the coil in turn; they are afterwards tilted over so as to discharge their contents. The accompanying figure shews an elevation of one form of apparatus constructed in

accordance with this invention. Two reels C are attached at opposite sides to the rotating shaft A, and a circular hood K partially surrounds them. The rod G is fed through the aperture O, and is coiled in its place by the reel being rotated by the friction cone F, which is on a stationary revolving shaft. When the operation is completed, the reel is revolved round the axis A in the direction of the arrow, and



the coil is discharged upon the lower end of the hood K; while at the same time the other reel is brought into position to receive a coil. J indicates a plate which serves as a brake for stopping the rotation of the reels when they are moved from an upright position. The shears S are disposed at the side of the platform L for the purpose of cutting off the rough ends of the coil, and they are operated by a crank P, a shaft M, and a belt from the motor shaft. The rotation of the reels upon their standards D is allowed by the screws I, which run in an annular groove round the spindles H. Nine claims are made for the rotation of the reels in evacuating their contents, and for the guard and platform K L.—No. 6163. April 25th, 1888.

## Advertisements.

D. P. W. India.

## IMPORTANT NOTICE.

All Civil Engineers of the Department are informed, that, owing to the extended support accorded to the Civil Engineers' Association, the Committee feel it necessary to still further widen their sphere of influence, and to delegate some of their duties.

The current work has been entrusted to Local Sub-committees, who will correspond with the Central Committee.

Every Civil Engineer is urged to write to the Hon. Sec. c/o Grindlay, Groom and Co., Bombay, who will put him in touch with his Sub-committee, with the view of enrolling him a member of the **Civil Engineers' Association.**



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HYDERABAD, DECCAN, }  
October 19, 1888. }

**NOTICE.**

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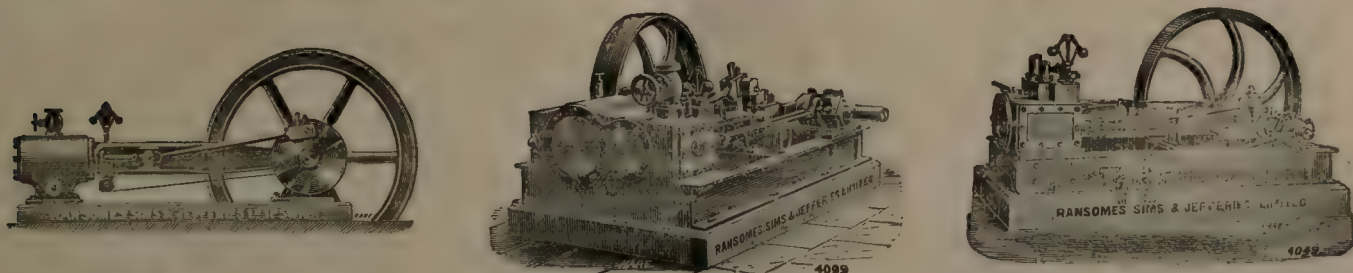
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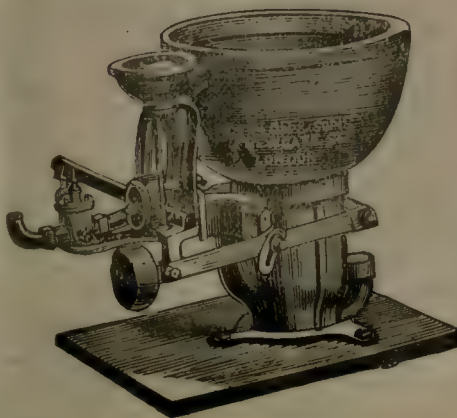
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INDIAN ENGINEERING.

SATURDAY, NOVEMBER 10, 1888.

IS THE GAME WORTH THE CANDLE ?

OF all the appliances requisitioned to lend a *couleur de rose* to Indian Administration Reports, that which is popularly known as 'Eye-wash' plays the most important part. An official document without this useful and necessary adjunct is like the play of Hamlet with the part of the Prince omitted ; it is stale, flat, and unprofitable ; what is worse it invites hostile criticism and exposes defects and shortcomings that had rather not see the light of day. At the same time, however, it must be admitted there is a certain amount of tact required to manipulate the 'Eye-wash.' When judiciously applied it covereth a multitude of sins and deformities, but if there is a bungling in administering it, the consequences are inconvenient, if not positively unpleasant, especially should the head of the executive happen to see through the ugly, flimsy device.

The other day we had occasion to review the Report on the Madras Civil Engineering College, and pointed out, on the admission of the authorities themselves, what poor return the public got by the up-keep of that institution. Now we have a report of what may be considered a sister institution, namely the Madras School of Arts, which discloses still more lamentable results.

That all is not gold that glitters, we will first review the annual report for 1887-88 and then examine the financial statement appended thereto, to see how far they go to establish the progress of the school. The number of students on the rolls at the end of the year was 299, a total increase of 34 on the number in the previous year ; "the increase since March 1888 is over 100 per cent." The average attendance was 197, or a total increase of 48. The largest number of students attended the class teaching elementary freehand of ornament and foliage from copies ; next come those who learnt freehand, model and geometrical drawing for the Middle School Drawing ; and the others proportionately low. As an instance of the popularity of technical education, and how students are attracted to it, the following is a safe guide. Among the new classes, there was one for architectural drawing, which commenced work at the beginning of the year and was attended by 20 students and apprentices ; another class for instruction in drawing, up to the first stage of the Preliminary Higher Examination, was started in July. Like all novelties in India the attendance went up like a rocket, the attendance for the first four months being 60 ; but by the end of the year it came down like the stick, and the paying students were represented by the number four ! The Director of Public Instruction, however, is sanguine in his expectations, notwithstanding these discouraging results, and thinks the class will increase in time and prove useful.

The examinations of which so much has been attempted to be made, are not encouraging ; the results are an-



nounced in such a cloud of words that one feels diffident whether to commend or to disparage it. Of 55 students who appeared for the Middle School Examination, seven passed in the first class, 13 in the second, and 12 in the third. The Higher Examination was scarcely more satisfactory. In geometry and measurement drawing the results were anything but good. The Examiners report:—"With regard to the whole examination, the Examiners are of opinion that in the mechanical work of the students, there is considerable room for improvement, and they would insist on more methodical work and a higher standard of neatness and exactness. In more artistic branches," (we presume from an ornamental point of view) "such as foliage drawing, light and shade study, and more especially in design, the work is very fair and creditable to the students." In the matter of scholastic attainments in English, the result is still more deplorable. Out of a total of 299 students 134 could only read and write English and 151 Hindus were ignorant of that language. The total number of scholars and apprentices was 49. Even the Museum failed to attract visitors, for the number during 1887-88 was 48,997 shewing a falling off of 9,961 as compared with the previous year. From the statement of accounts we find that instead of there being a surplus of Rs. 999 as anticipated, there was a deficit of Rs. 731; this was owing to salaries of sergeant, peons and other servants, who, though not in any way employed in the industrial departments, have to be paid from the profits of manufactures.

The Director of Public Instruction in his review of the letter of the Superintendent, School of Industrial Arts, congratulates him, which we suppose is another form of official compliment, on the appreciable increase in the strength of the institution, the number having risen from 265 to 299, or by 13 per cent. The standard of excellence is evidently computed by the quantity, and not the quality of results. Of course there has been an indiscriminate application of 'Eye-wash' which may have some effect on officialism, but the public are unfortunately too obtuse to accept it in the same light.

Descending to matter of fact figures, we find that they have been evoked to a precision such as we may hope in vain to find even in an official document. Under the head of receipts, the income from school fees and sales of manufactures is credited with Rs. 10,461. To this is added Government grant in its various forms at Rs. 23,252, and what with the outstanding on the 31st March of the present year, and stock and materials the handsome figure of Rs. 36,843 is reached. This by way of receipts only. But will any one have the goodness to tell us why the sum of Rs. 23,252, wrung from the 'masses' out of their hard earnings, living probably on one meal a day, should be appropriated for such a purpose—viz., to support 299 students at the rate of Rs. 77 for each pupil per year?

Not to carry the process of breaking a butterfly on a wheel further, we will reproduce an excerpt from the local *Journal of Education*, as to what value is placed upon such interested testimony. Referring to the foregoing account our contemporary says:—

We might have presumed that this was impossible, and that some portion of this large sum was due to expenditure in the manufacturing section, and might be laid to the account of the lion's cage in the People's Park and the Lady Grant-Duff cabinet. But this cannot be, for we find on the debit side large entries of sums paid out of "profits of manufactures." It is true that the only profit shewn on the credit side was a debtor balance, but that may be only an artistic detail. However, items of Rs. 21,425-2-4 are said to be 'met from the profits of manufactures.' A goodly amount of profit. On the other side of the account we find—Sale of Manufactures Rs. 9,334-12-0. Net Outstandings (taken as due to Manufacturing Department) Rs. 1,120-11-3. Increase of Stock and Materials Rs. 732-6-2, total Rs. 11,187-1-35. This is not profit, this is the gross return. So we have this remarkable fact; gross returns of Rs. 11,187 shew a profit of Rs. 21,425. Of course this is all nonsense, but it is what the report says. We may, we presume, take all expenditure 'met from profits of manufactures' as expenditure on manufactures, and this being so, so far from any profit there is a loss of Rs. 10,237-4-11. This is met as follows. Special Government Grant, Government Fixed Contribution, fees of the School Department, Rs. 9,505-11-6, leaving a debtor balance at the end of the year of Rs. 731-9-5. This takes no account of the value to the manufacturing department of the services of the Permanent Establishment for which Government pays separately to the tune of Rs. 13,118-11-0 per annum.

#### PETROLEUM.

SUNDRY scientists in religion who make the book of Revelations their special study every now and again announce the end of the world, the great battle of Armageddon and the triumph of the saints as a cataclysm to be expected immediately—if not sooner, a Yankee would say. Similarly sundry scientific doubters of Nature are fond of telling us every now and again that the world's coalfields are exhausted, that the world's fuel is all used up, and a new glacial period impending; *Credat Judæus Apella*. New coalfields are being discovered all over the world every year, there is every geologic reason to suppose will continue to be discovered and developed.

Your mere scientist lives *in* his books, and *on* his theories. He has very vague, somewhat distrustful, very distressful ideas about the values and uses of practicality. Practicality, however, is not at all "touchy," and will, when the need for its services is perceived, readily come to the rescue. Coal suppositiously failing. Why not in the guise of petroleum? Neither the American or Burman deposits are anything like worked out yet—or shewing any signs of such likelihood. The North-West is full of promise. And hardly ever do six months go by without our hearing of some new striking of "ile." On some Indian Railways it has proved where tried, a cheap, as well as an efficient, substitute for coal, as a factor towards motive power. For many



reasons, over and above cheap Railway working, we welcome therefore a Report on petroleum deposits in the Upper Assam Valley lately furnished to the Government of India by Mr. R. A. Townsend, Superintendent of Petroleum Works in Beluchistan. He speaks well of the oil supply, and holds out a prospect of coal as well, as the reward of exploitation. He estimates the probable, profitably workable area at 700 square miles. But that is not all, or anything like all.

Mr. Townsend tells us, even as other competent authorities have told us, a vast tract of land within the Upper Assam Valley is known to have many shows of petroleum outside the above-named limits; and it should be carefully examined during a proper season of the year when the geological features can be studied from rock sections exposed in the dry beds of rivers and streams, and when locomotion with ease and certainty is possible: until this can be done, any attempt to define the area or limit over which oil may be mined for successfully in Assam would be presumption on my part.

Would it not be better to employ skilled men like Mr. Hughes, of the Geological Survey, on the work indicated instead of sending them to waste their time, and incur opprobrium, at places like Hyderabad, where *amlagham* jealousies and suspicions, and greeds, will always defeat energetic pursuit of science?

Development of an oil trade in Assam is no new idea. Attempt at it was made twenty years ago. An attempt that failed commercially from various causes. Chiefly for lack of cheap and easy transport to consuming markets; partly because of inexperience. Certainly not because of lack of oil. Experience has been gained now that good communications have been established. What between the Brahmapootra Steam Flotilla and the new Railway, Assam has little to complain of in the way of communications—could have little difficulty in despatching oil to market, if so minded. Artesian borings are cheap now-a-days; the demand for kerosine all over India is great, and is increasing. Petroleum prospects in Assam seem to us decidedly rosy. Mr. Townsend says so, more cautiously, and makes the admission text for a seasonable homily. Thus the time having arrived when the oil deposits of Assam are likely to be worked in a practical way, it will be well for the Government of India to devise some satisfactory method of dividing up the lands into plots for leasing on terms of mutual advantage to all concerned; and it will be found necessary also to establish rules governing the treatment of bore holes when made, and especially when abandoned. The rainfall of Assam is a phenomenal one, and the bulk of the country in which oil is likely to be found is a flat plain; conditions requiring great care in preventing surface water from flooding the oil measures by means of carelessly or ignorantly constructed borings. It may also be found necessary to relax somewhat the rules governing the reserved forests covering the tracts, at any rate in the pioneering stages of development, if for no other than sanitary reasons affecting the skilled laborers who will be forced to live near their works when once started.

## AMERICAN RAILWAY PASSENGER TRAVEL.

*Scribner's Magazine* continues its Railway articles. The one in the September issue deals with Railway passenger travel and has been written by General Horace Porter. In September 1825, the Stockton and Darlington Railway (12 miles long) was opened in England, George Stephenson acting as "driver," a man on horseback riding a little in advance of the engine to warn trespassers of the fearful fate which awaited them if they failed to get out of the way of a train moving with such startling velocity as ten miles an hour. It was not till 1829 that a locomotive engine was used on an American passenger track. It was one imported from England, and called the "Stourbridge Lion." When, in May 1830, the first division of the Baltimore and Ohio road was opened (a distance of 15 miles) horse power was employed. A primitive railroad notice informs intending passengers that "a brigade of cars" will leave the Pratt Street Depot at such and such a time. Although the word brigade has dropped out of the American Railway vocabulary it differs a good deal from the English one. *E.g.*, the Yankee driver is the Engineer, the Guard the Conductor, carriages are cars, the booking office is the ticket office, &c., &c. Conservative England has held fast to coaching styles and appellations that were dear in the days before Railways supplanted stage coaches. The coach was naturally the direct model of all primary Railway carriages. The writer in *Scribner* reminds his readers that England still retains the Railway carriage divided into compartments that bear a close resemblance, inside and out, to stage coach bodies with the middle seat omitted. Radically inclined America, at a very early stage of its Railway development, repudiated stage coach architecture, and adopted a long "car" in one compartment and containing a middle aisle which admitted of communication throughout the train. This car "was carried on two trucks, or bogies, and was well adapted to the sharp curvature which prevailed on our Railways." The introduction of Railways was received in America with fully as much distrust and dislike as in England, and at first the arrangements for passenger traffic were very crude. General Porter says:—

The railroad was a decided step in advance, compared with the stage coach and canal boat, but when we picture the surroundings of the traveller upon Railways during the first ten or fifteen years of their existence, we find his journey was not one to be envied. He was jammed into a narrow seat with a stiff back, the deck of the car was low and flat, and ventilation in winter impossible. A stove at each end did little more than generate carbonic oxide. The passenger roasted if he sat at the end of the car, and froze if he sat in the middle. Tallow candles furnished a "dim religious light," but the accompanying odor did not savor of cathedral incense. The dust was suffocating in dry weather; there were no adequate spark-arresters on the engine, or screens at the windows, and the begrimed passenger at the end of his journey looked as if he had spent the day in a blacksmith "shop." Then, the springs were hard, the jolting was harder, the windows rattled, the brakes were clumsy, and of little use.



There were no double tracks; there was no telegraph to facilitate the safe despatch and running of trains. Long journeys, when undertaken, have to be made over lines composed of a number of short, independent Railways, and the bewildered passenger had to transfer himself, buy a fresh ticket, personally pick out his luggage, as likely as not on an uncovered platform, in the rain. There has been transformation since then. Every year has its own record of progress effected. In 1849 the Hodge hand-brake was introduced, in 1869 George Westinghouse patented his air-brake, by which power from the engine was transmitted by compressed air carried through hose; in 1871, the vacuum brake was devised. A difficulty under which American Railways suffered for many years was faulty car coupling. The ordinary means consisted of coupling pins inserted into links attached to the cars. There was a great deal of "slack," the jerking of the train in consequence was very objectionable, and the distance between the platforms of the cars made the crossing of them dangerous. In collisions one platform was likely to rise above that of the adjoining car, and "telescoping" was not an uncommon occurrence.

The means of warning passengers against standing on the platforms were characteristic of the dangers which threatened, and were often ingenious in the devices for attracting attention. On a New Jersey road there was painted on the car door a picture of a new-made grave, with a formidable tombstone, on which was an inscription announcing to a terrified public that it was "Sacred to the memory of the man who had stood on a platform."

The Miller coupler and buffer were invented in 1863, and were followed by the Janney coupler, and a number of other devices, the essential principle of all being an automatic arrangement, by which the two knuckles of the coupler, when thrust together, become securely locked, and a system of springs which keep the buffers in close contact, and prevent jerking and jarring when the train is in motion.

The first attempt to furnish the American Railway passenger with a sleeping berth during his journey was made in 1836 on the Cumberland Valley Railroad of Pennsylvania. A primitive and inefficient attempt at passenger relief. Each one cost about 4,500 dollars. In 1864 in a yard of the Chicago and Alton Railroad, Mr. Pullmann built his first car, the Pioneer, at a cost of 18,000 dollars—and was laughed at for his pains. He laughs best who wins. Three years afterwards the Pullmann Car Company was formed.

The story of its success, of the adoption of Pullmann cars all over Europe, as well as America, all of us know. All our readers may not know that in 1880, the Pullmann Company erected the most extensive "car works" in the world, at Pullmann, fourteen miles south of Chicago. Five thousand workmen are employed there; and an idea of the capacity and resources of the shops may be gathered from the fact that a hundred freight cars—what English people would call goods vans—have been built in them in eight hours.

In America a "Bureau of Information" is to be found at large passenger stations. There sits an official who, "with Job-like patience, repeats to the curiously inclined passengers the whole Railway catechism, and successfully answers conundrums that would stump an Oriental pundit." A good idea, this Information Bureau! In Europe, in India it is the third class passenger traffic that pays: in America it is the first. First class in America costs no more than third across the Atlantic. Third class travel is confined to immigrants from Europe.

The subject of Railway accidents is a delicate one. General Porter suggests that statistics regarding them are necessarily unreliable, because "Railway Companies are not eager to publish their calamities from the house-tops." Mulhall in his *Dictionary of Statistics* brings American Railways in guilty of killing and wounding on an average about four times as many passengers as are killed and wounded on European lines in the same space of time; about five times as many as Railway accidents in the United Kingdom are responsible for. General Porter protests.

We for our part have no means of judging to which side the balance of truth inclines—can only say that General Porter's apologia is not satisfactory; is indeed in itself suspicious.

#### ROAD-CONSTRUCTION IN THE VIZAGAPATAM AGENCY.

THE tendency of latter day thought is towards replenishments, restitutions, relevancies, in place of the wide area of scandal and surmise that used to have dominion. Siberia is no longer a trackless unexplored region, only fit for fictionists to glean sensational materials for their novels in, but acknowledged as a quite eligible place of residence. Madras is not second to Siberia in capacity for the reception of civilizing influences. So at least a State paper lately published on authority in that Presidency, leads us to conclude. We find it written in the said State paper *à propos* of a Through Siberian Railway:—

"It is a paradox that a huge territory abounding in every kind of potential riches should have been left pinning for the roads without which none of its resources can be rendered available. .... Siberia has been regarded as a wilderness simply because it was unknown. It was unknown and practically a wilderness because it was devoid of roads. Inquiry has demonstrated that it is a region of extraordinary fertility for a large part of its surface. Its climate, which was fabled to be (*sic*) and deadly, has been proved by experience to be generally endurable, and at some spots delightful, &c. Had half the energy, skill and money been applied to Siberian development, which have been lavished on rounding off Russian boundaries, the country would by this time have been a veritable treasure house."

The picture drawn is held applicable to the existent state of affairs in Jeypore. The Jeypore plains are said to be mines of agricultural wealth, not a whit inferior in economical degree to those of Siberia, and fully as worthy of being "promoted." To open roads through these



ghauts has, we are told, "been the aim of every Collector of the Vizagapatam District for the last five and twenty years." Evidently it is not altogether for nothing that Madras has earned a reputation as Slow and Benighted.

*Apropos*, it occurs to the writer of the Report we have under consideration, that if a Deputy Examiner were attached to the Superintending Engineer's Office to audit all the Public Works Accounts of the First Circle, and if the Superintending Engineer had in his own hands the authority now vested in the office of the Chief Engineer of Madras, Public Works in the relieved districts would proceed with vastly less delay, and with far more satisfactory execution than now obtains.

The Vizagapatam and Central Provinces trunk line is by responsible authority held to be "an indispensable work." Alignment of the road is shortly to be commenced. It has been settled that it is to touch the border near Borai. *Apropos*, consider this remark on the part of the Governor's Agent at Vizagapatam:—

"With regard, however, to the contemplated cost of this road on our side of the border, I enter a most serious protest against the estimates of the Madras Public Works Department. I am of opinion that the sanctioned estimates for the Pottingi-Koraput road are very largely in excess of the rates actually necessary; and these rates must not be taken as the criteria for work over the whole line. Putting aside the bridges, which are to be iron girder bridges—an innovation that is involved in doubt and great expense—I venture to say that the road work, excluding the larger bridges, ought to be completed for Rs. 2,500 a mile, whereas I understand that the earth-work, metalling and culverts are estimated to come to over Rs. 5,898 a mile. The soil is excellently adapted for road-making. There are few embankments or cuttings; nothing to pay for the land."

Here is a paragraph worthy of some attention:—

"Lieutenant-Colonel Fraser, R.E., says that it is 130 miles from Koraput to the frontier (by the route I advocate it is 115 miles), and he says 'at the low estimate' of the Pottingi-Koraput road, the total cost will be Rs. 13,50,000, and it will take 20 years to open it! The difference between the per-mileage estimates of the two Engineers is as follows:—

	Rs.
Madras estimate for 1 mile of road ... ..	10,384
Central Provinces do ... ..	3,053
My estimate is as follows:—	
	Rs.
Koraput to frontier, 115 miles, less 5 miles paid by the Maharajah, balance 110 miles. Earth-work, metalling and gravelling at Rs. 2,500 per mile ... ..	2,75,000
Bridging 18 nullahs, with a total water-way of 855 fset, at Rs. 65 per running foot ... ..	55,575
Constructing a raft for carts to cross the Indravati river ... ..	1,000
Two Supervisors, at Rs. 350 each per month for four years ... ..	33,600
	3,65,175
Cost of 20 inspection houses ... ..	10,000
Tools ... ..	20,000
	3,95,175
or in round numbers ... ..	4,00,000

## Notes and Comments.

**STRUCK OIL.**—At a jail in Minbu, in Upper Burma, the P. W. D. while digging a well at a depth of about 60 feet, discovered bluish shale strongly impregnated with earth oil. It is believed that a better yield of oil may be obtained at Minbu than at Yanangyoung.

**How LONG?**—Says the Ooty paper:—Delay appears inevitable with the Nilgiri Railway. Mr. Woolley who was to have left England about the middle of the current month, has been obliged, unavoidably, to postpone his departure till the end of the current or beginning of the next year. It is hoped that then the line will be started and no cause for further delay occur.

**JADE-STONE.**—There has been no increase in the value of this product sent away from Burma to China. In 1886-87 2,890cwts., valued at Rs. 5,61,000, were shipped, and in 1887-88 3,907cwts. of the value of Rs. 5,53,515. All that was available during the year was of poor quality. The trade was also greatly retarded by the unsettled state of the country in the neighbourhood of the jade-mines.

**THE SCARCITY OF FUEL AT DARJEELING.**—In a recent letter from Mr. Prestage, to the Chairman of the Darjeeling Municipality, he says that since 1874 the price of firewood has increased from Rs. 15 to its present cost of Rs. 32 per 100 maunds, so that one of our main necessities has in a few years more than doubled in cost, but what is still more serious is, that from the present control and working of our sources of supply, and the neglect to produce and reproduce, there is reason to fear that another 14 years may shew a further increase of cost of more than 100 per cent.

**INDO-EUROPEAN CABLES.**—The simultaneous break in the telegraphic communication between Australia and India, and between India and Aden, teaches a lesson, thinks a London journal, by which we should lose no time in profiting. At present, the only alternative route we have when our direct wires are disabled, is through foreign territory. This is a state of things which should not be allowed to exist longer than can be helped. It is, therefore, hoped that the Government will see their way to bring to a speedy conclusion the negotiations which have been for a long time pending for the laying of a direct cable between Vancouver's Island and Australia.

**THE G. I. P. RAILWAY.**—The Chamber of Commerce, Bombay, have addressed the Acting Agent of the G. I. P. Railway Company, Bombay, regarding the necessity which, in their opinion, exists for the immediate doubling of that line of Railway from Khandwa to Itarsi, and ultimately to Jabalpur. From the information at their disposal the Chamber believe that to provide for the traffic now existing, the capacity of that section of your system is already taxed to the uttermost during the busy season in April, May, and June, and that when the additional traffic which may be anticipated from the opening of the Midland Railway has to be dealt with, it will be impossible to transport it on a single line of rails.

**BRITISH ENGINEERING WORK IN EGYPT.**—Whatever may be doubtful in our dealings with that country, it must be admitted by our bitterest critic, unless he desires to forfeit all claim to candor, that we have labored hard under great discouragements to improve the physical condition of the people and to develop the great natural wealth of the soil. The improvements carried out under the able direction of Sir Colin Moncrieff and the staff of assistants into whom he has inspired his own enthusiasm,



confer, in their direct material enrichment of the populace, and in their indirect effect upon its moral character, a boon such as no rulers of Egypt, native or foreign, have dreamed of bestowing for centuries.

**A ROORKEE COLLEGE GRIEVANCE.**—The rules which are in future to govern the appointments to the upper subordinate grades in the case of Roorkee-passed students are likely to bear very hardly on the civilian candidates. We have the old and new rules before us, and in paragraph 16 of the latter we read:—"Twenty-five men of those who pass successfully—*preference being given to soldiers*—will be appointed as overseer apprentices, and will spend the third year of their training in acquiring the practical part of their education." The words we have italicised are those to which objection has been taken. In the old rules the same paragraph begins with the words, "All who pass successfully," &c., there being no special concessions to anybody.

**ADVICE TO INVENTORS.**—An American exchange says:—In testing the actual value of any new invention the cardinal question to be asked is: "How will the benefit to be derived by the use of this device compare with the trouble and expense of establishing and maintaining it?" It is the misfortune of the typical inventor the while he may be able to estimate with some degree of fairness the cost of his device, he is always prone to over-estimate the benefit to be derived from its use. The Patent Office records are full of the results of such men's work; the only result which they ever attained. There are thousands of things which it is quite possible to do, and which would result in *some* benefit; but they are not done, simply because this benefit is too high priced.

**SANITATION IN INDIA.**—Dr. Bidie, the Sanitary Commissioner of Madras, has come to the same conclusions as the Government of India and all the sanitary authorities in this country, to the effect, that but little can be done except under the advice of qualified Sanitary Engineers. In order also fully to carry out the plans of these Engineers it will be necessary to employ under them trained Sanitary Inspectors, as the Inspectors and Overseers at present employed for this duty are without any of the special knowledge required. Where to find them at present is the difficulty, but Dr. Bidie suggests that hygiene should be included in any scheme of technical education, when fairly educated men might qualify for Sanitary Inspectors, especially if the study were made obligatory.

**SYDNEY CITY RAILWAY.**—The Government of New South Wales are now considering a scheme of a comprehensive character for the City Railway extension. It is proposed to carry the line underground from the Redfern station along the western side of the City to a terminal station at the south-western corner of the Circular Quay. The Railway will then be carried by a semi-circular route, across the northern part of the quay under the Government House domain and the Botanic Gardens to Woolloomooloo Bay, and thence *via* Darlinghurst, Randwick and Waterloo to Erskineville station on the Illawarra Railway. It is proposed to have stations at various suitable centres along the whole route, and the line is intended to serve for suburban passenger as well as general goods traffic to and from the shipping in the harbour.

**THE MINERAL RESOURCES OF QUEENSLAND.**—The Report of the Department of Mines for the year 1887 is a very valuable contribution to the mining literature, and contains much information of a per-

manent, as well as some of only a transient interest. The principal feature of the report is the boom which has taken place in gold-mining. In 1886 there was greater activity as compared with the previous year, but last year there was a general forward movement, the result of which was an increase in the yield of gold amounting to 84,925 oz. Most of the old fields of the Colony contributed more of the precious metal than they did in 1886, and the new ones produced enough to mark the position they are likely to occupy in future amongst the auriferous localities of Queensland. In those fields where there was no increase it may be attributed to their remoteness from the coast, and the difficulty of access to them by drays carrying machinery.

**RAILWAY EXTENSION IN SOUTH AUSTRALIA.**—The Railway Commissioners have just returned from an inspection of the Great Northern Railway. They travelled to Anna Creek, 580 miles up the line from Adelaide, and thence to the present head of the line, Edward's Creek, forty miles further. The rails are laid to this point, but the earthworks are constructed twenty miles beyond, leaving about forty miles to Angelpole to be covered. It is doubtful whether the Railway will at present be extended beyond Condowie Creek. The Commissioners found the line in splendid order, and well and solidly laid. The country beyond Hawker is greatly in want of rain, the present season being the driest known for at least ten years. It is impossible to get stock through, as water has to be taken up by train, the supply at Coward Springs and other places not being suitable. Camels have been largely used in connection with the works, and were found to be almost invaluable.

**MUNICIPAL BUILDING RULES.**—A Rangoon contemporary suggests with reference to the Rangoon Municipal Secretary's notice that certain amendments are to be made to the *Rules regarding buildings*, that the Engineering Department of the Municipality design plans of buildings suited to the different classes of the lots in town and prepare specifications and estimates. These, with the usual form of application, could be lithographed and printed at a cost which could be recouped by fixing a price for each class of design, so that any person willing to build could call at the Municipal Office and purchase the complete project for the dwelling he intends building. Such a plan would save the tax-payer much worry and trouble in having to tip underlings to prepare plans and get the matter sanctioned by the Municipality, while those who might want fancy designs of their own will be in the minority and can pay for obtaining their requirements. We believe that like suggestions were offered in our columns with reference to the Building clauses of the Calcutta new Municipal Act.

**A GROUYNE AT THE SANGAM ANICUT.**—The head and under-sluices of the Sangam anicut are set back behind a rocky spur which juts out into the river. This spur causes a deposit of sand and silt in front of the head sluice. The levels shew that this deposit is 3 feet to 4 feet above sill of head sluice and 5 feet to 6 feet above sill of under-sluices. The levels also shew that the deep stream keeps a good way out from the head sluice and bunds round sharply to the under-sluices. To increase the water action in front of the head sluice and so diminish the deposit formed there, it is proposed to construct a groyne about 225 feet in length at right angles to the anicut up-stream. It will have a top width of 9 feet and slopes of  $1\frac{1}{2}$  to 1. Its foundation will be carried at least 3 feet below sill of under-sluices. It will be formed of stones not less than



3 feet in depth carefully packed and wedged up resting on a core of stones averaging  $1\frac{1}{2}$  or 2 cubic feet each, which will be carefully packed, all interstices being grouted with quarry rubbish. For a length of 25 feet from its nose the groyne will be formed entirely of large stones without a core of small stones, and the nose will be sloped off at  $1\frac{1}{2}$  to 1. The groyne will be built up to levels of 103.50 at its base and 101.00 at its nose. The estimated cost is Rs. 2,958.

**A GIGANTIC DRAIN.**—The Nallamada Drain, in the Kistna Western section, starts from the Nallamada surplus sluice in 42nd mile of Commamur canal, where it receives drainage from 428 square miles of country above the canal. It runs nearly due south for a distance of 7 miles, and then runs in an easterly course for a distance of 4 miles, where it falls into the Tungabhadra drain. A little above the 5th mile from its head it receives the Pundla affluent, having its head in 37th mile of canal, draining 195 square miles, being the area drained by west branch of Nakkavagu, also above the canal. The delta area drained by the Nallamada and its affluent below the Commamur canal is only 22 square miles. The drain from its head to the infall of the Pundla affluent will have a bottom width of 166 feet, will run 7 feet deep, and have a bed and surface fall of 0.8 foot per mile, and from here to its infall at the Tungabhadra, it will have a bottom width of 189 feet; bed and surface fall and depth of water being the same. With a depth of 7 feet at the head the discharge is about 3,055 feet per second; and with a depth of  $9\frac{1}{2}$  feet, the discharge would be 5,200 cubic feet per second, or about  $\frac{1}{4}$ th that given by Ryves' formula, with a co-efficient of 450. This is considered sufficient as a tentative measure for the present. The estimate, amounting to Rs. 1,35,065, is sanctioned from the balance of Rs. 4,72,286 available for improvements to the Tungabhadra drain and its affluents.

**PUBLIC WORKS IN COCHIN.**—The total expenditure on Public Works during the year (1886-87) was Rs. 3,79,764, being Rs. 24,625 in excess of the previous year. The most important works to the advancement of which this sum was devoted were the further improvement of the irrigation works at Moolathurai, the extension of the ghât road to the coffee cultivation on the Nelliampathy Hills, and the improvement of the road between Trichoor and Vaniampara. Of the total expenditure, the Public Works Department accounted for Rs. 2,12,143 and the District Officers for Rs. 1,67,620. Another important work, which should be noticed, is the improvement of the road between Shoranur and Trichoor, with the aim of finally converting the road into a Railway. The carrying out of the improvements in this direction is impeded by the objections of landholders on the line to a diversion of the existing road; but more might be done than is being done, in view to establishing a Railway connection between the navigable canal 8 miles south of Trichoor and the Madras Railway line at Shoranur. The Malabar portion of the Trichoor-Shoranur road, lying between the Shoranur bridge and the Railway station, is invariably in a worse condition than any part of the road in the Native State, and the same remarks apply to other roads. Two hundred and ninety-five miles of road have been maintained during the year at a cost of Rs. 112 per mile, and the wants of the public have been well attended to in this respect, whilst the attention being paid to irrigation works shews that the interests of the agricultural population have not been neglected.

## Current News.

MR. E. J. McCUDDEN, F.R.S.A., Executive Engineer, passed through Lahore on his way to join the Batinda line.

THE first through train to Bhopal left Jhansi yesterday morning, with Mr. Wright, Traffic Manager, and Mr. Brock, Locomotive Superintendent.

THE platelaying on the main line of the Indian Midland Railway is completed, and through trains to Bhopal will commence running from the 5th instant.

THE cyclone in Southern India has played great havoc with the telegraph lines there. Telegraphic communication with the Madras Presidency is disorganized.

COLONEL PEMBERTON, Secretary to Government of India, Public Works Department, will leave Simla on the 9th instant for Umballa, and thence to Calcutta on the following morning.

MR. HARRIS, Engineer-in-Chief of the Gwalior State, has been stopping at Jhansi, and has gone on to Karera, where he is building barracks for fifteen hundred of Scindia's troops.

WE understand that none of the officers of the Office of the Director-General of Railways, at Simla, go to Calcutta this cold weather, with the exception of the Director-General himself.

MR. G. R. MACDONALD, Deputy Accountant-General, has arrived in Lahore, and the Special Committee, appointed to report on the system of accounts in the Public Works Department, commence their work at once.

As Lieutenant-Colonel E. Harvey, R.E., is placed on duty as one of the Public Works Accounts Committee, the charge of the 3rd Circle of Superintendence of Public Works vacated by that officer is now held by Mr. T. E. Ives.

A DESPATCH has been received by the Viceroy from the Secretary of State, creating Burmah into a Lieutenant-Governorship at the close of the present financial year. Sir Charles Crosthwaite will most likely be the first Lieutenant-Governor.

DURING the recent cyclone at Madras a night train of twenty-one carriages capsized near Chingleput and lay in a dangerous position overhanging the lake within a foot of the water, which was over twelve feet deep. The passengers remained in this situation for hours owing to the non-arrival of assistance consequent on the interruption of the telegraph.

MR. J. D. WRIGHT, Superintending Engineer, has left Umballa en route to Bombay and England, on three months' privilege leave of absence. His appointment has been filled by Mr. E. E. Oliver, and the Under-Secretaryship to Government in the General Branch of the Public Works Department, vacated by Mr. Oliver, is now held by Mr. J. E. Hilton.

AN accident occurred the other day at the works on the Bengal-Nagpur Railway, which will probably delay the progress of plate-laying for about a fortnight. A flood on the Damooda had undermined a temporary bridge, and it gave way while some trucks were crossing. Happily there were no serious casualties, three men who were slightly hurt having quite recovered.

At the recent meeting of the National Electrical Association of America, the President stated that there were now in use in the United States 192,500 arc lights, 1,700,000 incandescent lamps, and thirty-four electric railways with 233 motor cars in full operation. Forty-nine more roads are in course of construction. In six months the capital invested in electric plant increased by £8,400,000.

THE open-line section of the Bengal Nagpore Railway from Nagpore to Rajuandgaon, which has been converted to broad gauge, and the extension to Raipore, were inspected by the Consulting Engineer on Tuesday and Wednesday of last week, preparatory to opening the whole line from Nagpore to Raipore on the broad gauge. The inspection was satisfactory, and as soon as Government approves the Consulting Engineer's report, the line will be opened. This will probably be about the 15th instant.



## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

### THE PRESENT STATE OF THE INDIAN P. W. D., AND ITS PAST HISTORY.

#### II.

8:2 —It was about 1868 that the first Civil Engineers' Committee was formed in Calcutta, and from time to time it presented memorials to the Government of India on the grievances of the Department. These harped mainly on the following points which were felt to be the only basis of a satisfactory organization of the Department, and these with exception of (1) remain the demands of the C. E.'s to the present day.

1. Abolition of the term "Uncovenanted."
2. Equality of pay for all members of the same grade whether Civil or Military.
3. Promotions to be proportionate between Civil and Military members.
4. Management and control of State Railways to be similarly proportionate.
5. Complete separation of Civil from Military works.
6. Transfer of Military officers from higher posts in the Military Works over the heads of Civil Engineers in Civil branches to be stopped.
7. Improved pension Rules.
8. Improved retirement Rules.
9. Representation on the Secretary of State's Council.

These requirements, though they seem to embody the most elementary justice, and are but requests for fulfilment of the promises of 1869 and 1870, were distasteful to the Royal Engineer Secretary to Government for Public Works, and in 1876 an order was promulgated prohibiting memorials by any class of its subjects in Government service, and ruling that all persons wishing to memorialize must do so severally and individually. The fear of official displeasure thus awakened, caused the Committee of Civil Engineers at Calcutta to be dissolved, and for a while all went on merrily, the Public Works Secretariat having successfully stifled the appeals of the Civil Engineers for promised justice.

These facts in a few years becoming known in England, the natural result followed, and the supply of candidates for admission to the College (which was at first ample) steadily declined, and at last dwindled down to such a ridiculously low figure that competition became no longer possible. Thus what had happened in the years 1869-1871 (paragraphs 6 and 9) again occurred, and English gentlemen not unnaturally declined to allow their sons to enter a service that labored under such grave and serious disadvantages.

By 1879, however, no less than 299 Engineers from Cooper's Hill had entered the Department, and these, together with the hasty importations from guaranteed Railways and other sources, had filled the ranks of the Department to overflowing. The policy of Government in regard to public works had changed. It was considered advisable to employ more largely private enterprise and capital, and to partially abandon State construction, and the supply of Engineers in the Department was found to be redundant. There were, moreover, among the men so hastily recruited some who never had any proper training for the works they were employed on, a very few were strongly suspected of helping themselves to the savings which their insufficient salary did not admit of their legitimately economising, and to crown all the want of a consistent Public Works policy led to an almost complete stoppage of funds.

Under these circumstances when, during the years 1879-80, the expenditure in the Public Works Department was, in consequence of the financial crisis then prevalent in India, restricted to the absolute and immediate necessities of the country, the Government of India suddenly discovered that it must forthwith reduce the very large establishment that had been collected in the reckless manner already described. The reduction was accordingly made by the simple plan of arbitrarily dismissing about 200 Civil Engineers from the service of Government. A shew was made, at the same time, of relegating a few of the Royal Engineer officers of the Public Works Department to military duty, but as these gentlemen were subsequently re-introduced into the Department, after a short period of absence from it, and in many cases in higher positions than they formerly held, this proceeding in reality left the Royal Engineers of the Department better off than they were before, and allowed the full brunt of the reductions to fall upon the Civil Engineers.

This last point has perhaps been made too much of in relation to the reductions of 1879, and those now impending, for though an undoubted hardship to the C. E.'s, it is unavoidable, because if it is necessary to keep up a certain number of Royal Engineers in India, it is incumbent on Government, in the interests of the public service, to employ them in the P. W. D. rather than pay them for doing nothing.

In the following year it was felt, even in the Simla Secretariat, that to engage men on indeterminate promises and dismiss them *en masse* summarily when no longer required could

not be regarded as a Public Works policy, and that some kind of re-organization was imperative. Accordingly a Committee, which consisted of—

Major-General A. Fraser, R.E.  
Major-General J. S. Trevor, R.E.  
Major-General J. Crofton, R.E.  
Colonel W. S. Trevor, R.E.  
Major A. J. Filgate, R.E.  
Mr. A. B. Sampson, Secretary.

sat to discuss the terms which should be offered. If this Committee, leaving alone the question of Military pay (drawn by R. E. officers over and above the Civil pay of their grade) had seen their way to recommend the Government of India, whose advisers they were, to loyally carry out their promises of equality given by the Government of India in all other respects, to give the C. E.'s the same promotion, the same pension, and the same furlough allowance as the officers of their own corps serving in the Department, it is more than probable that a healthy tone would have set in and the present difficulties have been obviated. This, however, was not the case. The proposals of the Committee left these matters untouched. It ignored absolutely the statements, from time to time, put forward by the Civil Engineers themselves. It called no Civil Engineer to give evidence before it, and it evolved the following

#### SUMMARY OF PROPOSALS.

- I. That retirement at the age of 55 be compulsory.
- II. That no promotions to a higher class be made after the age of 50.
- III. That no alteration be made in the classes, grades and pay of Chief and Superintending Engineers.
- IV. That the several grades of Executive Engineers be merged into a new class called Divisional Engineers, with salaries commencing at Rs. 650 per mensem rising by monthly increments of Rs. 25 for each year of approved service up to a maximum of Rs. 1,050. Such increments not to commence till an officer has entered on the 37th year of his age. In the case of officers now drawing higher pay than the above minimum increments not to commence till they have entered on the 43rd and 49th years of age, according as they belong to the 2nd or 1st grade of Executive Engineers.
- V. That the present Assistant Engineers be broken up into two classes, to be called Deputy and Assistant Engineers, each divided into two grades. That the salaries of Deputy Engineers be fixed at Rs. 500 and 450, and of Assistant Engineers at Rs. 300 and Rs. 250 per mensem.
- VI. That the number of Deputy and Assistant Engineers be fixed on a proportion which will ensure promotion to the rank of Divisional Engineer in less than 16 years, and to Deputy Engineer in less than 7 years.
- VII. With a view of securing this rate of promotion that the following proportion be for the present accepted as the sanctioned scale of the Department:—

Chief Engineers	2	}	47	} per 100.
Superintending,,	5			
Divisional	40	}	53	
Deputy	28			
Assistant	25			

VIII. That the net pay of R. E. officers be added to the consolidated salaries on the proposed scale of their departmental appointments in order to place them on an equality with other military officers of their rank\* employed on the ordinary staff of the army; and that in future all military officers be brought on to the consolidated Civil departmental salary and be no longer allowed to draw Staff pay and allowances.

Officers who may at present be drawing more than is admissible under these rules, to be allowed the difference as a personal allowance until it disappears with the increase of consolidated pay.

IX. That these proposals be submitted to Government with an intimation that their adoption will involve an increase in pay of Rs. 7,200 and in pension of Rs. 800 per mensem.

These proposals were never made public, but they leaked out and were felt to be so manifestly in favor of the military officers and so much less than had been held out to the Civilians when they joined the Department, that they were felt to be impossible, even apart from the probable result of their adoption which would have been to keep all administrative appointments in R. E. hands, and the Committee and its labors were relegated to the limbo of failures. It is only mentioned here as marking both an epoch in the history of the P. W. D. and as shewing the spirit in which the increasing discontent was met.

The fears created in the minds of the Civil Engineers by the reductions of 1879 and the recommendations of the Committee of 1880, led to an interchange of views among the Civil Engineers of the department which grew into the Civil Engineers' Association sitting at Bombay, and which concerted measures to bring their case before the ultimate tribunal of all English subjects, the Imperial Parliament. The result of frequent interviews with, and numerous letters to the Secretary of State for India, and of questions asked in the House by Members of Parliament who generously and most disinterestedly gave their time and trouble to look into the injustice done the Civil Engineers, was the Despatch 18 P. W., dated London, 22nd March 1883.

\* Italics are ours.



This despatch laid down that—

2. The objects embraced in this re-organisation should be—

- (a)—The reduction of the numerical strength to such proportions as will suffice for the work to be done.
- (b)—The re-adjustment of the grades so as to make promotion more rapid.
- (c)—The offer of terms of retirement which will have the effect of accelerating promotion and providing members with a superannuation allowance justified by their service and age.
- (d)—The determination of the proportions in which establishments shall be recruited by Royal Engineer Officers, by Civil Engineers from England, and by passed students (chiefly natives) from the Colleges in India.

And to secure these ends provided the following means :—

- (1). That the Government should have power to call on officers not promoted to Superintending Engineer, to retire at 50 years of age.
- (2). That pensions as per scale below should be given.

*On Medical Certificate.*

No. of years service.	Pension per Annum.
	Rs.
10 ... ..	1,000
11 ... ..	1,400
12 ... ..	1,800
13 ... ..	2,200
14 ... ..	2,600
15 to 19 ... ..	3,000

*Without Medical Certificate.*

20 to 24 ... ..	4,000
25 and upwards ... ..	5,000

applicable to all the European Civil Engineers of the P. W. D.

- (3). The institution of a Provident Fund.
- (4). That the number of Executive and Assistant Engineers should be equalized.
- (5). That the latter should obtain an increment of Rs 50.
- (6). The reduction of the Royal Engineer's pay by the stopping of Military pay proper.
- (7). Their due share of appointments in the Administrative posts to be given to Civil Engineers.
- (8). Their removal from the ranks of the Uncovenanted Service.

After a promulgation of this Despatch which, if acted upon, would have partially met the Civil Engineer's case (although they had never contemplated the reduction of the Royal Engineers to the C. E. level). A minute on the Despatch was produced by Colonel W. S. Trevor R.E., (though generally believed to be the joint production of Major Begbie, R.E., and Captain Broadbent, R.E.)

Colonel Trevor commences by comparing the emoluments of Royal and Civil Engineers, and subsequently discusses the point as to whether the Government can, with justice, order reduction of the scale of pay of Royal Engineers now in the Department. It is demonstrated that if the Secretary of State is willing to grant to Civil Engineers the scale of pensions proposed in his despatch, the much-desired assimilation of their position to that of Royal Engineers serving in that Department, will have been practically effected, or at least so nearly so that the withdrawal of the net military pay of the latter, in addition to the grant of improved pensions to the former, would reverse their respective positions in respect to emoluments. This solution of the relative position of the two classes is arrived at by a good deal of elaborate calculation and actuarial detail which is based on very questionable information, among the rest Hannington's tables, which are widely divergent from the actuals of the past 20 years. The conclusion reached is, moreover, falsified by the fact that because R. E.'s are so fortunate as to be paid for 3 years, British service and are allowed to count this service as Indian service for pension. Colonel Trevor has deducted a proportionate amount of their pension merely saying that it is not departmental service. He also considers the net military pay which is received and can be accumulated month by month for life, at interest, as if it were a lump sum paid on retirement.

He further adds "to reduce the allowances of the Royal Engineers in order simply to assimilate their emoluments to those of the Civil Engineers, would afford the latter no satisfaction; and their grievance, which is not that others get more pay, but they do not get enough, would be untouched."

"If any Civil Member of the Department have seriously agitated for the reduction of the Royal Engineer's pay, it is not by any feelings of empty jealousy that they have been actuated."

He then recommends an incremental scheme which is a mere return to that of 1880.

After this document had seen the light, the Despatch of the Secretary of State, directing the assimilation of the pay of Royal and Civil Engineers, was suffered to become a dead letter, and, finally, owing to the pressure brought to bear by the Royal Engineers in India and in England, the Secretary of State has been induced to cancel his Order of 22nd March 1883, and thus to continue to the Royal Engineer officers of the Public Works Department the higher rate of pay than that given to the Civil Engineers of the same rank in the Department. It will thus be seen how a matter on which both the Secretary of State and the Government of India had long and consistently pursued an un-deviating line of policy is, immediately a definite order is promul-

gated, actively opposed by the Royal Engineer rulers of the Department; and how, in consequence of that opposition, an order, based upon facts and despatches well and carefully considered, is deliberately rescinded in face of the repeated declarations establishing the propriety of the conclusions originally arrived at. After this signal instance of their power, it is idle to contend (as is sometimes done) that the Royal Engineers are not the *de facto* rulers of the Department.

It was evident, however, that these measures could not be final, and in August 1883 Government called together the first representative Committee of the Public Works Department to consider the effects of the Despatch and make proposals. Its members were :—

Mr. G. Molesworth  
 „ H. Bell  
 „ R. A. Way  
 „ C. Vincent  
 „ E. Pinhey  
 Major Marshall, R.E.  
 „ Hall R.E.  
 Mr. P. Dangerfield  
 „ W. A. Lesmond  
 „ Cregeen  
 Baboo Madhub Chunder Roy.

This Committee commenting on the Secretary of State's Despatch and Colonel Trevor's minutes pointed out giving full detail in support of their contentions.

(1) That the abolition of the term "Uncovenanted" was a valuable concession the grant of future concessions involving no precedent.

(2) That the pension scheme would have been liberal if given in sterling.

(3) That the proposed admission of Asiatics at  $\frac{2}{3}$  pensions was just.

(4) That as Government of India could not raise a 4 per cent. loan at par, the concession of the Provident Fund was illusory, and where compulsory, is of the nature of a forced loan.

(5) That the Despatch omitted to remove the disabilities in leave rules under which certain classes of Engineers engaged in India labored.

(6) That as the Government of India had admitted that the C. E.'s were underpaid, it was no relief to them to cut down the R. E.'s to their level.

(7) That in any case the R. E.'s in the Military Works Department, P. W. D. should not lose their military pay.

(8) That complete separation of the latter from the P. W. D. in all grades should be effected, so that the translation of Superintending Engineers in that Department, over men in other branches of the P. W. D., should be stopped.

(9) That the promotion and possible reductions between Civilians and R. E.'s should be impartial.

(10) That the alteration in the number of the grades 1st, 2nd, 3rd and 4th Executives to the proportions of 8, 9, 10, and 12 instead of 8, 9, 9, 4 seriously injures the three lower grades.

(11) That if the above were coupled with the proportion of 2 to 1 between Executives and Assistants it would be of tangible benefit.

The Committee further proposed—

(A) To adopt a sliding scale to convert the sanctioned proportion of 1 to 1 gradually into 2 to 1.

(B) To introduce the 50 year rule at once, giving adequate compensation to the men retired.

It may be noted that during the progress of the Committee the incremental scheme, whose chief recommendation appeared to be that it would facilitate the exploitation of the Department by the Royal Engineers, was overthrown mainly by the energetic steps taken by the Civil Engineers' Association, to collect the opinion of the Department and so convince the members of the Committee beyond doubt of the extreme unpopularity of the measure.

With regard to this scheme proposed by Colonel Trevor in his minute on the Despatch, they pointed out that the whole results in which he brought out that the Royal Engineers were now equally treated with the C. E.'s were fallacious.

(1). Through ignoring the British service of the R. E.

(2). By considering his Military pay as given him in a lump at end of service, instead of at intervals during service.

(3). By assuming Rs. 12=£1.

They further point out that the source of officers' emoluments is of no importance in comparing their prospects.

A curious commentary on Colonel Trevor's recorded opinions that the improved Pension Rules had secured practical equality between the R. E.'s and C. E.'s is given by the concluding paras. of his note on the Despatch of the Secretary of State, which ran :—

"That they (the C. E.'s) will never desist from agitation until they have succeeded in substantially improving their pecuniary position, and being at least as well remunerated as the R. E.'s. I have no doubt whatever; and that they will ultimately succeed may, I think, be safely assumed."

"Government had better, therefore, make a merit of necessity than yield grudgingly under pressure. The cost would only be about Rs. 7,500 per mensem to every hundred C. E.'s." It may be accepted "as a foregone conclusion the Government will in the



run long have to yield to the organized impotency of the C. E's, backed as it appears to be by influence of the entire profession at home, and bring their emoluments up to the same level as those the R. E's now enjoy."

This after saying that their emoluments were equal.

The Committee then separated and it was speedily seen that their deliberations were to have no effect whatever, and that the only modification of the Despatch in spite of the promise noted at foot \* would be the continuance of the military pay to the Royal Engineers, and as if to point the Secretary of State's remarks.

"Apart from the question of promotion, pay, and pensions, there are other points connected with the Civil Engineering section of the department which I consider it desirable to refer to. I have been made aware that there is among the Civil Engineers an impression that they do not receive their due share of the appointments in the Secretariats, or in the Department of Railway control. I do not know how far there is real ground for complaint on this score. Nor do I desire to interfere with the discretion which is exercised by the authorities in India in the selection of individuals for certain offices. I will only express my confidence that the choice of fit persons will be made with perfect impartiality, and that no grounds will be allowed to exist for such apprehensions as those which have been expressed."

VERITAS.

### BRAKE TRIALS ON FRONTIER RAILWAYS.

SIR,—In your issue of 27th October I notice an article headed "Brake Trials on the Frontier Railways" which is, I think, very misleading. The fact is not stated that the Westinghouse, in making the 75 yards stop, broke the train into two parts, and also had 150lbs. of air pressure to the square inch, which is double their stated working pressure. In making another stop they broke a draw hook and a screw coupling, which left the train in three parts. In the eyes of any practical Railway man, a brake that damages the rolling stock in the above manner, to say nothing of the serious delays that would be caused, is far from being suitable for the everyday working of a large system of Railways, like in India.

With regard to the length of trains worked by both systems of brakes, they were exactly the same, as far as the brakes were concerned, as each train was fitted with twenty-six sets of apparatus. The article also seems to give the idea that only the Vacuum has to put on an extra inlet valve to each coach, this is not the case, as the Westinghouse have also to add an inlet valve to every coach, and their trial train on the Bolan was fitted with this valve. I might here add, that the Vacuum brake with the quick acting valve is fully applied on the end of a train of 50 coaches in 3½ seconds, which is slightly quicker than Westinghouse, and this valve would have been used in the recent trials, had the Vacuum Brake Company been given time to fit up a train with it.

With regard to the assertion made by the advocates of the Westinghouse brake, that the India rubber piston packings and washers of the Vacuum brake will not stand the climate, this has been entirely disproved by the fact that the Vacuum brake has been working for the last five years on the G. I. P. and the B. B. and C. I. Railways, and also on the late narrow gauge Bolan Railway where it has given the greatest satisfaction.

October 31, 1888.

S. T. GRESHAM.

### THE BOMBAY P. W. D.

SIR,—Let me ask space in your paper for remarks on the doings of our Dutch friend, the Governor of Bombay, who, as we all know, is at his little games again! The P. W. D., Bombay, is being further disorganised, and in view of a coming time of scarcity, if not of famine, it is well that it should be so; there being nothing like freedom from conventional or departmental rules and trammels when it is necessary to cope with an important crisis. We have hitherto had in this Department two Chief Engineers and three Superintending Engineers and the senior Chief has been the Chief Secretary to Government. We are now to have two Chief and two Superintending Engineers, "who will be the advisers of Government for matters within their respective divisions," and we are to have any one chosen from the Department to be Depart-

mental or Chief Secretary, and "the advice and opinion" of Chief and Superintending Engineers in matters connected with their districts "will not be liable to be criticised or over-ruled by the Departmental Secretary, who will ordinarily be their junior." The intention of this is perfectly clear: the "ordinarily junior" officer will be the nominee of the Government of the time being, instead of being able, even if by experience fit to do so, to give an independent opinion, he must be the tool, silent or otherwise, of his nominator; it is therefore only a blind to say that the opinions of senior officers will not be liable to criticism, &c., by a junior. All the author of the Resolution wants is to be freed of the nuisance of having an independent experienced and straightforward Chief Secretary as his Departmental adviser. This is known from his treatment of Chief Secretaries in other departments.

Now, Mr. Editor, this looks like rather a radical change in the constitution of an important Department, a constitution too that has worked well until the arrival of a Governor who looks upon Chief Secretaries as magnified head clerks, and himself as a sort of deputy omniscience. Even our most autocratic Governor, Sir R. Temple, did not go so far, but he was an administrator of experience, not an amateur and theorist, and knew how to make use of the knowledge and experience of those under him. This radical change, moreover, is being made within about a year (a long year sad to say) of the end of the reformer's or destroyer's reign; we may call it one of the dying efforts of a moribund Governor: and for the sake of the "Kingdom" let us hope it is one of the last.

As for the pliable Departmental Secretary, in whose interest the change has been made—personally there is nothing to be said against, but every thing in his favor, but as a Departmental officer, his qualifications are only cleverness, a great capacity for work, and long experience of 20 years in Secretariat work—first as personal assistant to the Chief Engineer, and then as Under-Secretary to Government in the P. W. D., both in Irrigation and in the "dry" branch. For only three months, I think, had he an Executive charge. He is consequently totally out of touch with both the work and with the officers of the Department; and this officer is to be in the position of having the final say to the Governor in all matters concerning the whole residency, for it is a transparent dodge to say that their opinions, &c., will not be liable to be criticised or over-ruled by his.

That the Government of India should have agreed to such a change in the constitution of the Bombay P. W. D., seems to me to indicate that they were not fully aware of the qualifications of the appointee to the post of Departmental Secretary, but the delay in gazetetting the appointment (for the Resolution is weeks old, and the appointment not yet gazetted) gives a faint hope that some hitch has occurred that may lead to the cancellation of the Resolution.

October 28, 1888.

"DISCONTENT."

### IRRIGATION IN BEHAR.

SIR,—The failure of the later showers has caused the loss of the rice crop in this and other neighbouring districts to a large extent, and it has thrown a gloom over the people, and specially on the working classes. The price of rice has gone up, and rice dealers are already trying to introduce famine rates. The last Behar famine was in 1873, or about 16 years ago, since then there was some pinch in the northern part of this district which, however, was got over with no difficulty. This year the southern parts of Behar are mostly affected, and it is generally believed measures of relief will be needed. I make these preliminary observations as a prelude to the Engineering questions involved in the repeated occurrences of these droughts, to which I shall come presently.

It may be in the recollection of many what vast sums of money were spent in the Behar famine, and mostly on road-making, under the idea that on the occurrence of another famine, rice would pour into the country from the surplus produce in other parts. No one will deny that this does meet the want in some shape; but to enable the distressed people to pay for the food, works have to be provided them which cannot be found on the existing roads, or new ones started for the occasion, and even if sufficient work can thus be provided, the multiplication of high roads in high lands is an evil rather than good; such roads do not remove the cause of the failure of crops, and, therefore, there must be some mistake in ignoring this fact. It is said that when rains are scanty, the crops must fail. This is the most superficial view of the matter. The rains were heavy enough this year in July and August and even in early part of September, but where did all this rain water go? I found daily at my place that the river (Ganges) rose as high this year as last year, though the rise did not last as long as the previous year, but it still shews that the vast body of water which finds its way into the Ganges, and is alternately carried back into the sea, was enough to irrigate the high lands from whence it came, only if means were provided to catch it at the proper places. I shall not refer to large irrigation projects, as the Orissa and the Sone Canals, which though gigantic in character, meet the wants of limited areas; and therefore are to a certain extent non-

\* P. W. 197.

INDIA OFFICE, S.W., 3rd April 1883

SIR,—Adverting to your interview with the Earl of Kimberley on the 14th February last, and to your letter of 19th idem, I am now directed to inform you that the Government of India have been made acquainted with the views of the Secretary of State in connection with the re-organisation of the Engineering branch of the Public Works Department in India.

Lord Kimberley observes that you are under the impression that the present disparity of the pay of the Civil and Military Engineers will be maintained. This is not the case. It is intended that they shall in future receive the same amount of pay.

I have the honour to be, Sir,  
Your obedient Servant,  
J. K. CROSS.

E. H. CARRUT, Esq., M. P.,  
10, Hyde Park Gardens, W.



effective. The general system of irrigation in Behar is what is called the *Ahera* system, by which a successive series of catchwater bunds, something like a horseshoe, is through against the drainage of the country in low lying places, at intervals across the slope of the country. These *Ahera* or catchwater bunds, if effective, are capable of storing water to irrigate the standing crops in September and October; but unfortunately they are not perfectly kept up or provided with sluices for the passage of the surplus water, generally they are breached by the first rush of water into them, and then spasmodic efforts are made to patch up the damages. Where several ryots take the water from one *Ahera* it becomes generally nobody's business to attend to it, and the zemindar's *gomasta* beats only the bush and not the game when he attempts to coerce all these people to contribute their quota of labor to repair the catchwater tank. Next to the *Ahera* system is the *Daur* system, which is simply canalling on a small scale but this also is very ill-regulated and it leads very frequently to deadly feuds between rival zemindars and their respective ryots.

The above is sufficient to shew the necessity of a local Irrigation Department. Whether it should be placed under the District Board, like the District Roadwork Works I cannot say—perhaps it should be under the District Board. The next question is who is to pay for such works? There can be no doubt that the zemindars interested should pay for it; but the zemindars will say that they already pay the Public Works Cess, for which they get no return, and that after paying the Public Works and Road Cesses they have no margin left for the improvement of their property. Having received the Public Works Cess, for which the Government gives no return to the zemindars, the former is under certain obligation to meet the exigencies of droughts and famines; and when the Government undertakes to discharge this obligation it should spend its resources for the benefit of the zemindar and ryot by effecting improvements in irrigation works. If the Government could give up half the Public Works Cess for a local irrigation agency, I believe the people would come forward with an equal amount for improving the existing means of storing and supplying water.

While on this subject, I cannot conclude without referring to the scheme of emigrating the so-called surplus population of Behar to Burma, which is at present being discussed by the Government of India. Now, when we speak of a surplus population, we mean that the country where such a surplus exists has been well developed, so much so, that there is no work for them. Is this the state of things in Behar? No one I presume can say that the country in which no irrigation system exists to entail the safety of crops is so developed as to leave no work for its people. Then in Behar there is the fact that the people are living still in the primeval state of buffeting against natural causes, which destroy the fruits of their labor, and because the Government won't step in to help them to regulate and subdue nature, the population must be removed to Burma. In Eastern Bengal, again, the climate destroys the population simply for want of good water to drink, just as in Behar want of irrigation works destroys the food of the people for failure of an over plentiful rain. Against these drawbacks the only remedies sought are road-making and emigration to Burma, while Engineering talent languishes for want of work, and the recruiting business flourishes with vengeance.

AN OBSERVER.

## IRRIGATION IN THE PUNJAB.

### IV.

SIR,—I beg to send you the following further remarks in continuation of those already published on the subject in your valuable Journal.

*Mozaffargarh Inundation Canals.*—For some occult reason there is no Capital account kept of these canals, which are nevertheless believed to be a full-blown Executive Division.

The Examiner's Office Establishment must be extremely hard worked, or greatly underhanded, to be unable to keep an account of capital expenditure incurred on these canals, as, without this, all other information is next to useless. Looking at the accounts entered in the Revenue Reports it is observed that the

Earnings amounted to	...	Rs. 3,51,765
The Working Expenses were	...	" 1,51,740
Showing a profit of	...	Rs. 2,00,025
deducting on account of the previous year, however	...	" 9,436

The nett profits are only ... Rs. 1,90,589

Not bad certainly; but, as before stated, until the capital expenditure is ascertained and entered, the other entries are of little use.

The iniquitous "Zurnaga fund" is also in force on these canals, to which the same remarks apply as those on Lower Sutlej and Chenab system of canals.

*Shapoor Inundation Canals.* This is a small system of canals taking out from the left bank of the Jhelum in the Shapoor District, initiated and entirely constructed by a former Deputy Commissioner of this District, it is believed the late Financial Commissioner, Sir W. Davies, is the officer to whom these canals owe their existence, and judging from the accounts entered yearly

in the Provincial Irrigation Revenue Report they are beyond compare the most successful canals in the Punjab, as they return from 35 to 42 per cent. on the capital expenditure incurred on them, which at the close of 1886-87

Amounted to	...	Rs. 40,739
The Earnings were	...	" 26,596
The Working expenses	...	" 11,426

Leaving a profit of ... Rs. 15,170

Being 37.24 per cent. on the capital expended, while in the previous year the profits were Rs. 13,869, being 34.04 per cent. on the capital invested.

The area irrigated was 10,729 acres and the estimated value of the produce raised Rs. 1,26,058, against Rs. 1,90,633 the year previous. Surely these results should encourage the Government to invest largely in constructing new, and improving and extending the time-honored institution of Inundation Canals in the Province, which it is earnestly hoped will be done.

His Honor the present Lieutenant-Governor having served both as Financial and Settlement Commissioner of the Province, has enjoyed exceptional opportunities of becoming intimately acquainted with the working of the Provincial canals, Perennial and Inundation, he is therefore in a manner bound to utilize the experience he has undoubtedly acquired in these responsible positions.

With these remarks the papers on Punjab Irrigation for the year 1886-87 conclude, reserving for a future paper certain suggestions as to further development in this direction, which occurs to the writer as not only perfectly feasible and highly desirable, but absolutely necessary to the safety of the Province in years of scanty rainfall.

### SUGGESTED EXTENSION OF THE PUNJAB SYSTEM OF CANALS.

To a person not behind the scenes the apparent abandonment of an important portion of a project such as the Bari Doab Canal assuredly was when projected, may appear, to employ a mild term, a little eccentric. As previously stated, this is precisely what has been done, a most important portion of the original project for the Bari Doab Canal has never been carried, namely, the legitimate and urgently needed extension to within a few miles of Mooltan. Instead of this, numerous other works that might reasonably have waited, such as the great Sirhind Canal project, the Sidhnai and Chenab Canal projects, have all been projected, and the former completed, or very nearly so, and the two latter now well advanced; while the first canal attempted in the Province has never been completed at all, and the surplus water allowed to flow aimlessly and uselessly in the parent river at Neazbeg and Vahd respectively, whereas the Neazbeg escape might be easily diverted into the main line somewhere above Raivind and the main line continued down towards Mooltan until it met one of the Chenab Inundation Canals, or now the Sidhnai Canal. Thus utilizing every cubic foot of the water which for years past has been running to waste. A feeder canal might be taken from the Ravee, near Neazbeg, where the river forms a loop, and thus enable the now parched deserts to be irrigated and made to produce excellent grain crops, where at present only a jungly uninhabited waste exists. If irrigation was available for this tract villages would rapidly spring up, the land cleared and cultivated, and grain exported to England *via* Kurrachee. The Railway has been in existence through the very heart of this jungle close upon 26 years, but the local grain traffic is believed to be nil, or very nearly so. Whereas, had the extension of the canal been carried out simultaneously with the Railway in 1862-63, what is to this day a howling waste would have been fifteen years ago under cultivation producing abundant crops to the zemindar and revenue to the Government. As the Sidhnai Canal is now drawing towards completion, it is earnestly hoped the long delayed extension of the original canal of the Punjab will be undertaken at once, and thus give the work a chance of realizing the high expectations of its projectors—Lord Napier of Magdala, the late Colonel J. H. Dyas and General James Crofton, &c.

A canal is now under construction from the Chenab, taking out from the river at a point below Wazeerabad. It is believed a much better site, for a canal head and weir could have been obtained at the village of Aknoor, where the river enters British territory at the foot of the Jammu hills, where presumably abundance of building material is available, and although the Sialkote District, being the best well-irrigated district in the Punjab, the command of level for "Flow" irrigation downwards would amply compensate for the extra excavation involved had the canal been fixed higher up the river.

As it is, a feeder canal should be taken out from Chiniote, tailing into and feeding the present new Chenab Canal, which could thus be made to tail into the Sidhnai Canal head at Serai Sidhoo, near Mooltan, which district would then be almost entirely irrigated as the Sidhnai should be carried down to Jelalpoor, discharging its surplus water, if any remained, into one of the Lower Sutlej Canals about that point. The old bed of the Beas can be distinctly traced by the cultivation in the old Channel between Geelawalla and Lodhrán, on the Indus Valley Railway; and if the people so gladly cultivate the ancient bed of the Beas, how much more so would they if water for irrigation was to be had. The crops raised in the bed of this old river are almost the only sign of life between Soojabad and Lodhrán, on the Indus Valley Railway.

E B.



## General Articles.

### THE OYSTER REEF LIGHT-HOUSE.

NOTE BY COLONEL A. M. LANG, R.E.,  
Chief Engineer, British Burma, on the *Oyster Island Light-house*,—dated the 21st July 1884.

#### III.

If the light formerly on the Oyster Reef is to be replaced, we have four alternatives:—

- (i) to re-erect a light-house on the reef;
- (ii) to moor a light-ship on the site;
- (iii) to raise the Savage Island tower, put on it a 1st class light to protect 18 miles; then to put a 12-mile light on Oyster Island;
- (iv) to place a 16 or 18-mile light on Oyster Island and put a stronger light in the present Savage Island tower.

(i) The experience of the two screw-pile structures on the Burma coast, "Krishna Shoal" and "Oyster Reef," will deter Government from repeating this form of light-house. It appears that the material and bracing of the Oyster Reef light-house were in excellent order: it was to all appearances in the same condition as it had been in past years when it had weathered succeeding monsoons and frequent gales; but the intensity of cyclones cannot be calculated and predicated, and we are not justified in exposing the lives of light-house-keepers even if we are prepared to risk money in taking the chance of such a structure in the late light-house on Oyster Reef withstanding every cyclone which may visit it: especially when it is not essentially necessary to select this site for a light. However strong and well put together and well designed the structure may be, it has to face conditions dangerous and unsuitable. Twenty-four feet of water cover the reef at low water: hence the foundations are practically inaccessible: 24 feet of staging are unbraced: the leverage of the dwelling-house and lantern perched far above high-water level is very great on the long iron piles: the vibration must be ceaseless: wind and wave acting always more or less in the monsoons with great violence, and in a cyclone (as has been proved) with irresistible fury. It may be assumed that no second screw-pile light-house will be erected on the reef and no other form of rigid structure is possible.

(ii) If this be admitted, a light can be exhibited from the reef by means only of a light-ship. Even if it would be possible for a ship to live at her moorings over or close to this reef, on this exposed shore in a cyclone or a very heavy gale, this form of light is not economical: the first cost is great and the subsequent upkeep is a perpetual tax on our finances.

(iii) As we have the power of shewing a light which shall cover the dangerous reef, without being placed on or closely adjacent to it, we are bound to do so in preference to incurring the risks of reef light-house or light-ship. We can erect a shore light-house on Oyster Island and cross its light with that on Savage Island. The question as to whether our main light should be on Savage Island and our lesser light on Oyster Island is essentially one for sailors to decide. I gather from the accompanying papers that shipping generally makes for Akyab not direct from the south, but from the west and needs protection from the reef from this (west) direction: that a 12-mile light on Oyster Island would not sufficiently protect the reef 9 miles distant: in thick weather, and with a misty atmosphere, a light with this nominal and extreme range would not cover the reef. So that whether the Savage light be raised or not, a long-range (16 mile) light is wanted on the Oyster Reef.

(iv) If this be so, we must accept the necessity of a 16-mile light on Oyster Reef: and in this case there seems no necessity to incur also and at the same time the cost of raising Savage Island tower, though we may increase the range from that site at a comparatively small cost by replacing the present 3rd class by a 1st class light on Savage Island.

2. Accepting then this last alternative No. (iv), it remains to discuss the nature of the light-house. To ensure the range required it must be a tower 120 feet in height, and it may be of wood, brick, stone, wrought or cast-iron.

3. The site is a factor in the problem and should be first considered. The information on this point is not sufficient; but pending further survey, borings, analysis of stone, &c., we may assume that Oyster Island is a permanent, non-volcanic island of rock (sand-stone) of structure similar to the outcrops on the main land about Akyab: that it is well above high water level and affords sufficient space both for the light-house and for separate accessory buildings. If this be so, we are saved from several difficulties.

Our light-house has not to withstand the direct shock of storm-driven waves: its vibration will not be excessive, nor need its form and material be of the same strength as is needed in such structures as the Eddystone or Alguada. It need not contain in itself the habitations of the keepers, the tanks, and store-houses. We need not devise peculiar or difficult foundations, nor are we bound to design the several parts of the structure so as to have a maximum facility of handling and easy carriage.

4. We may assume generally that our light-house will take the form of a—

(A) solid platform above the sweep of the highest waves.

On this will be grouped the—

(B) keeper's quarters and store-room;

from among which will rise—

(C) a tower 120 feet high, which will be destined only to carry the lantern, with a staircase of ascent thereto, and probably a hollow central case for hauling up stores, &c., to the lantern and in which the clock mechanism weights can fall.

5 (A). In regard to the platform we—

(i) require advice as to the level to which, having regard to the rise of tides and height of storm waves in the locality, our platform should be carried;

(ii) the form of surface of the island: the character of the rock as affecting the question of our foundations;

(iii) the character of the rock as suitable or not for ashlar or for concrete material.

Our platform would probably be a mass of concrete, faced on all sides with ashlar stone masonry and covered with stone flagging.

6 (B). The buildings would be of stone or brick, simple buildings with accommodation sufficient for the dwellings and cook room of six or seven Native light-keepers: store-rooms for light-house stores; and for water-tanks.

7 (C). The tower, being intended to be thoroughly permanent, would not be of wood, but either of stone or iron. Wood is not only less durable than these last-named materials, but it is also liable to be destroyed by fire, as in the case of Rudyerd's light-house on the Eddystone road. Stone, well selected for durability, is the most lasting material. It is also the strongest to withstand wind and wave. But the forces of wind and wave on a shore light-house (as opposed to an exposed tower rising strictly from a submerged rock) is not so great as to demand absolutely the use of stone masonry.

If therefore there be other sufficiently compensating advantages in favor of iron over stone, the latter need not be adopted as our building material in this case. And I think in the two very important points of *time* and *cost*, the advantage is in favor of iron.

8. I have had sketches and brief descriptions prepared (and hereto annexed) of some types of light-house, which may be studied in connection with this case. As masonry types are shewn—

(a) the new Eddystone, granite;

(b) the Alguada, granite;

(c) the Double Island, rubble and brickwork.

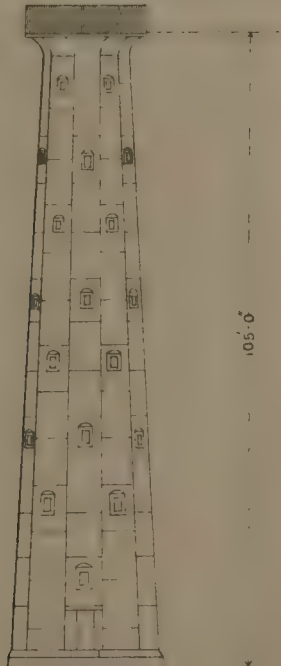
As iron types shewn—

(d) the Cocos or Table Island, cast-iron plates;



AL

CAST IRON LIGHT-HOUSE TOWER,  
GIBB'S HILL, BERMUDAS.



Elevation.

0 10 20 30 40 FT  
Scale 1/32

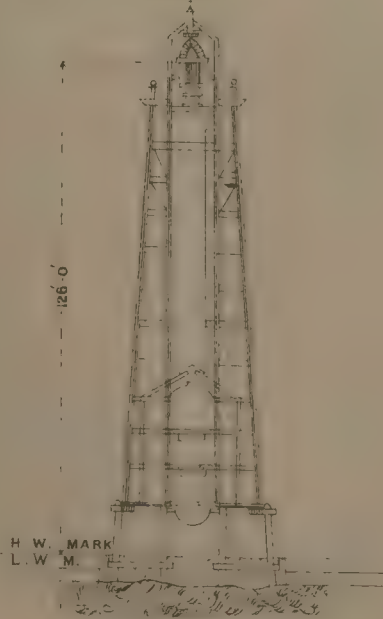


Section.

HIGH WATER  
LOW WATER

40 30 20 10 0  
Scale 1

USHRAFFEE LIGHT-HOUSE  
Section.



50 40 30 20 10 0  
Scale 1/50







- (e) Gibbs' Hill, Bermuda, cast-iron plates;  
 (f) Ushraffee, Red Sea, wrought-iron framing.

9. It will be seen on reference to these notes that of the masonry structures—

(a) the new Eddystone, 138 feet above rock, built off the English coast under every advantage that the wealthiest country in the world could provide, and with all the plant and appliances which experience and the highest Engineering skill could devise, took four years to build and cost £59,255 = Rs. 7,30,000;

(b) Alguada, 141 feet above rock bed, took 7½ years to build and cost £100,000 or Rs. 12,00,000;

(c) Double Island, only 64 feet above ground, took 2½ years to build and cost Rs. 90,340.

Judging from the above data, we could not expect to build a masonry light-house 120 feet high on Oyster Island under four years, or for less than five lakhs of rupees.

Of cast-iron structure—

(d) the Cocos, 91 feet high, took three years to build and cost Rs. 1,17,916;

(e) the Gibbs' Hill, 110 feet high, took one year to build and cost Rs. 95,000.

Of wrought-iron structure—

(f) Ushraffee, 144 feet high, took a year to build and cost Rs. 2,20,000

From these data we might expect to build now-a-days an iron tower 120 feet high in less than two years and for perhaps 1½ lakhs of rupees.

10. In any case I am of opinion that an iron tower on the site proposed could be built in less than half the time and at one-third the cost of a stone masonry tower.

11. Under these circumstances I strongly urge that the new light-house should be of iron. In this position, above the reach of the sea, cast-iron would be safe from the chemical action of salt-water; and here a structure built of plates of this metal would be secure from the blows of waves which in an exposed deep-sea tower, striking now this part and now that, set up vibrations varying in amplitude and intensity and tend to break up the building. Although these wave-blows, and the consequent incessant tremor to which a deep sea light-house is exposed demand the mass and weight which perhaps only a solid stone structure can offer: yet a shore light such as our proposed Oyster Island tower, which is not subjected to this ceaseless vibration, need not rely solely on inertia, but can trust to a comparatively light construction whose strength shall result from the judicious disposition and excellent workmanship of its framing.

12. Such a construction is offered by either of the systems shewn in accompanying notes on the Gibbs' Hill and Ushraffee light-houses. The former (of cast-iron) appears to be the cheapest. It consists of concentric plates of thickness varying from 1 inch to ¾ inch, the largest being about 7 feet by 6 feet. These plates are easily handled and easily put together by screw bolts through their flanges. The core of the tower is a hollow column of cast-iron, 9 inches inside diameter, in pieces each about 11 feet long. Iron floors at intervals break up the tower into chambers, iron staircases leading from chamber to chamber. The lowest, 20 feet, are weighted and hearted with concrete, having a central 8-foot diameter well. This structure being all of iron, violent storms of lightning are rendered perfectly harmless by the conducting power of so large a surface of metal. In my opinion a tower, almost a *fac-simile* of the "Gibbs' Hill light-house," will suit the conditions of our case.

13. If this be agreed to, I would leave the exact details of form and construction to the adviser of the Secretary of State, as the light-house (if it be of iron) must be ordered from England through the Secretary of State; who, whether we send a complete design and specification or not, will submit it to experts much more competent than any one here to decide on the structural details which the more recent experience has shewn to be the best for iron light-houses under any given conditions.

14. I would therefore advise—

- (i) a survey of Oyster Island;
- (ii) exact delineation of its surface above high flood-level with levels of every part;
- (iii) borings at probable sight of light-house;
- (iv) analysis of several specimens of stone;
- (v) determination of height to which our building platform should be carried;
- (vi) estimate for this platform and the keeper's and store buildings;
- (vii) communication to Government of India for transmission to Secretary of State of above particulars with indent for a light-house complete, founded on the masonry platform and standing 120 feet, clear above the rock surface, to the base of the lantern. The light-house to be more or less a replica of the Gibbs' Hill tower.

#### ALGUADA REEF LIGHT-HOUSE.

The Alguada Reef consists of two totally distinct ridges of rock running parallel to each other, separated by a channel a quarter of a mile wide and of a depth varying from 2 to 3½ fathoms.

2. The rock of which the entire reef consists is sandstone, scored into parallel and alternate ridges and gullies by the incessant action of the waves.

3. The rise and fall of spring-tides is about 9 feet.

4. The light-house is constructed upon a plateau of nearly 100 feet in width, composed of a solid mass of rock, with an average height of 1.1 above high water spring-tides.

5. The Alguada Reef light-house was begun in 1857-58 and completed in 1865. It is a *fac-simile* of the Skerryvore constructed by Stevenson on the west coast of Scotland.

6. The Alguada Reef light-house is constructed of granite throughout and is 165 feet high from foundation to top of lantern, as below:—

		Ft.	in.
Foundation to high-water level	...	4	9
High-water level to lantern	...	144	3
Height of lantern	...	16	0
Total	...	165	0

7. The external diameter at base is 42 feet and at top 16 feet; and the form of the light-house is obtained by the revolution of a rectangular hyperbola about its asymptote as a vertical axis.

8. The first 26 feet of height above high-water level is a solid frustum containing about 27,110 cubic feet: immediately above this level the walls are about 9.5 thick, whence they gradually decrease throughout the entire height of the shaft until at the belt they are reduced to 2 feet in thickness.

9. Above the shaft rests a cylindrical belt 18 inches deep, which is surmounted by a cavetto 6 feet high and having 3 feet of projection.

10. The cavetto supports an abacus 3 feet deep, the upper surface of which forms the balcony of the tower, and above it rests the parapet wall and the lantern.

11. There are nine rooms in the light-house, which are utilized as—

- (1) water store;
- (2) coal store;
- (3) workshop;
- (4) provision store;
- (5) kitchen;
- (6) and (7) sleeping-rooms;
- (8) visiting officer's room;
- (9) oil-store.

12. The outer courses of stone are joggled and the entire light-house is constructed of granite set in lime and surki mortar. (N.B.—Since painted with Portland cement.)

13. The granite was quarried specially for the work at Kalagauk and Singapore by Chinese and Madrassi labor,



the average cost per cubic foot of the former being Rs. 6-6-0 and of the latter Rs. 5-1-0.

14. The total cubic contents of the light-house is 58,580 cubic feet and the estimated cost approximately as below:—

	Ra.
(1) Building the tower entirely of granite, including machinery, labor, and materials, at Rs. 52,353 per cubic foot ...	3,06,687
(2) A 1st class dioptric, holophotal apparatus, including lantern, dome, eight lenses and holophotal prisms, revolving machinery and stores ...	35,000
(3) The fittings of the tower ...	27,300
(4) Cost of depôt at Diamond Island ...	25,000
(5) Cost of tender and boats ...	15,000
(6) Contingencies ...	20,449
<b>Total</b> ...	<b>4,29,436</b>

or, say, Rs. 9 per cubic foot of contents and Rs. 2,600 per running foot of height.

15. This was the estimated cost of the work, but the actual cost, as nearly as can be ascertained, was nearly £100,000, or more than double the estimated rate.

#### GRANITE LIGHT-HOUSE.

149 feet above rock-bed.  
144 feet above high-water level.  
42 feet diameter at base.  
16 feet diameter at top.  
26 feet above high-water level, solid.  
9½ feet thick walls at 26 feet above high-water level.  
2 feet thick walls at top.  
58,580 cubic feet of granite.  
£100,000 nearly or, say, Rs. 12,00,000 at present rate of exchange.  
Time, about 7 years.

#### COCOS LIGHT-HOUSE.

This light-house stands on the south-west end of Table Island, Cocos group, eastern part of the Bay of Bengal, at an elevation of 209 feet above high-water mark.

The building is an iron tower in the form of a conic frustum, 91 feet high, painted in alternate rings of red and white. The focus of light is 77 feet above the base and 195 feet above high-water, exhibiting a fixed white dioptric light of the first order which can be seen from a ship's deck 22 miles in clear weather. The cost of the building was Rs. 1,17,916, giving  $\frac{1,17,916}{91}$  = Rs. 1,296 per running foot.

Commenced in 1863 and lighted on 15th February 1867. Time, say, 3½ years.

#### EDDYSTONE LIGHT-HOUSE.

For several years the safety of Smeaton's light-house had been a matter of anxiety and watchful care to the Corporation of Trinity House, owing to the great tremor of the building with each wave-stroke during heavy storms from the westward, more especially when from west south-west. The joints of the masonry had frequently yielded to the heavy strains imposed on them, and the sea water had been driven through them to the interior of the building. The upper part of the structure had been strengthened on two occasions, namely, in 1839 and again in 1865, with strong internal wrought-iron ties extending from the lantern floor downwards to the solid portion of the tower.

Lately, however, that portion of the gneiss rock on which the light-house is founded has been seriously shaken by the incessant heavy sea strokes on the tower, and the rock is considerably undermined at its base.

In the new light-house it was determined that the elevation of the focal plane of the light should be 130 feet above high-water, by which the end of the light will be increased from 14 to about 17½ nautical miles, so as just to overlap the range of the lights at the Lizard.

The new light-house is provided with a first order light and a fog signal of maximum intensity of a distinctive character.

The new tower, which is constructed entirely of granite, consists of a cylindrical base 44 feet in diameter and 22 feet high, having its upper surface 2½ feet above high-water of spring-tides. From this base springs the shaft of the tower, 35 feet 6 inches in diameter at the commencement and 18 feet 6 inches in diameter under the cornice, the top of which will be 138 feet above the rock. On the cylindrical base there is thus formed a platform 4 feet 3 inches wide. The tower is to be solid with the exception of a water-tank to the level of 25½ feet above high-water spring-tides. It will be a concave, elliptic frustum, the generating curve of which has a semi-transverse axis of 173 feet and a semi-conjugate axis of 37 feet.

At the level of the spring-tides the walls will be 8 feet 6 inches thick, diminishing to 2 feet 3 inches at the top.

The tower contains nine apartments 10 feet in height in addition to the lantern, the seven uppermost being 14 feet in diameter. The whole of the work is dovetailed and cemented horizontally and vertically on the system adopted in the Hanois, Wolf, and other light-houses. The total net quantity of granite in the work is 62,133 cubic feet and the actual cost of the work was £59,255 =  $\frac{£59,255}{173}$  cost per running foot from lowest point of foundation to top of vane — £342-5 — Rs. 4,450 per running foot.

This granite light-house is—

138 feet above rock.  
133 feet high above high-water level.  
35½ feet diameter at base.  
18½ feet diameter at top.  
25½ feet above high-water and solid.  
8½ feet thick walls at 25 feet from base.  
2½ feet thick walls at top.  
62,103 cubic feet of granite—4,668 tons of granite.  
Cost, £59,255 — Rs. 7,30,000.  
Time, about four years.

#### DOUBLE ISLAND LIGHT-HOUSE.

The original design for Double Island light-house was for a cut granite tower, but this having been considered too expensive by Government another design was submitted for a brick tower with the foundation and lower story of rubble granite, cut stone being employed only for the coping on which the sole plate of the lantern rests, for the cornice of the balcony, and for the arch over the tower doorway.

The total of the estimate, including the light apparatus, amounted to Rs. 61,538, though the actual cost comes to Rs. 90,340. The rubble granite and cut stone were prepared at Kalagauk. The total height from foot of foundation to top of light-house is 64 feet, giving a cost of  $\frac{90,340}{64}$  — Rs. 1,412 per running foot. The foundation footing is 6 feet wide with a batter of 1·7 to ground-surface, where the width is 5 feet. The light-house at ground-level is 28 feet exterior and 18 feet interior diameter, the wall diminishing from 5 feet at base to 3 feet at level of first floor, which is 14 feet above ground-level. This portion of the light-house is built of stone, the upper story being composed of brick, and decreasing from 3 feet at base to 2 feet at balcony.

The projection which supports the balcony is 18 inches broad and 12 inches deep, the railing being 3 feet 6 inches in height. The parapet, which supports the lantern, is 9 feet deep and 1 foot 6 inches thick, and composed of ashlar masonry.

The girders and flooring of the light-house are of wood. The lantern is 18 feet high from base to vane, the focus of the light being 134 feet above high-water level.

Commenced in 1863, lighted in December 1865. Time (say), 2½ years. Cost, Rs. 90,340.

#### CAST-IRON LIGHT-HOUSE TOWER, GIBBS' HILL, BERMUDAS.

The form of the light-house, the base of which is 245 feet above the level of the sea, is that of a strong conical



figure 105 feet 9 inches in height, terminated at the top by an inverted conoidal figure 4 feet high instead of a capital.

The external shell of the tower is constructed of 135 concentric cast-iron plates including those for the doorway. These plates vary in thickness from 1 inch at the base to about  $\frac{3}{4}$  inch at the top; they have cast-iron flanges on the inside 4 inches broad, including the thickness of the plate, and are further strengthened at intervals of 12 inches by angular feathers  $\frac{1}{4}$  inch thick. Holes are drilled in all the vertical and horizontal flanges 6 inches apart, and the plates are united to form the tower by square-headed screw-bolts  $\frac{3}{4}$  inch in diameter with nuts and washers. In the centre of the tower there is a hollow column of cast-iron 18 inches in diameter in the inside, the thickness of the metal being  $\frac{3}{4}$  inch for supporting the optical arrangements and in which the weight of the revolving apparatus descends.

This column was cast in nine lengths, each terminating with circular flanges to which the floor-plates are bolted. At a height of 2 feet above each floor there is an opening into this hollow column 26 inches high and 15 inches wide to which wooden doors are fitted. It is used during the day for passing stores up and down and it likewise contains the waste water-pipe.

About 20 feet of the lower part of the tower is filled in with concrete, leaving a well in the middle about 8 feet in diameter faced with brickwork. There are seven floors, exclusive of the lantern floor or gallery, each 12 feet in height. The first and second floors are cased with brickwork and serve as oil and store rooms; the five upper floors are lined with sheet iron, No. 16 gauge, disposed in panels, with oak pilasters, cornices, and skirtings.

On the first floor there is a cast-iron kerb 10 inches wide and 1 inch thick, on which a cast-iron floor-plate  $\frac{5}{8}$  inch thick is fixed by bolts  $\frac{3}{4}$  inch in diameter. The inner edges of this and of all the other floor plates in the tower are bolted between the flanges of the corresponding parts of the hollow column by  $\frac{3}{4}$  inch bolts, nuts, and washers.

The second floor consists of 10 radiating cast-iron plates  $\frac{5}{8}$  inch thick extending from the brickwork to the hollow column; these plates have flanges on their under side and are held together by  $\frac{3}{4}$  inch bolts at intervals of 6 inches.

The other floors are similarly constructed, but the outer edges rest on the upper flanges of the shell, being bolted to it by the same bolts which connect the flanges of the plates of the shell. There are five windows in each floor, one in the centre of every alternate plate in the circle; these windows are 18 inches square and are fitted with strong wooden posts opening outwards, in which a plate of polished plate glass  $9 \times 5$  inches square is fixed for giving light when the port is closed. There is also a window of the same dimensions in the circular wall for admitting light to the staircase, making 36 windows in all.

The staircase consists of two wrought-iron stringers  $1\frac{1}{4}$  inches square, the rises and supports being  $\frac{5}{8}$  inch thick with oak treads  $1\frac{1}{2}$  inches thick. To each step there is an iron balluster  $\frac{7}{8}$  inch in diameter, on the top of which is fitted a wrought-iron handrail  $1\frac{3}{8}$  inches wide and  $\frac{5}{8}$  inch thick. From the level of the bottom of the doorway to the landing in the first floor the staircase rises spirally round the hollow column, the balluster and rails being on the outer edge of the steps, whilst from the first to the eighth floor the staircase runs spirally round the respective rooms, the ballusters and rails being in the inner edge of the steps.

There are standards and rails round the headways of all the floors; the standards are of wrought-iron  $3\frac{1}{2}$  feet in height and 2 inches in diameter at the bottom, tapering to  $1\frac{1}{2}$  inches at the top. A wrought-iron ring in four pieces, 5 inches wide and  $\frac{5}{8}$  inch thick is attached to the under side of the 8th floor by screw-bolts  $\frac{1}{2}$  inch in diameter to which the lantern and light-room are bolted.

The height from the gallery to the centre of the light is 11 feet and from the centre of the light to the top of the vane is 17 feet, making the total height of light-house 378 feet 9 inches above level of high water. The light can be seen from the deck of a vessel at a distance of 26 or 27 miles.

The total cost of the light-house, including lighting apparatus, was £7,700 nearly, or say Rs. 95,000, or say Rs. 950 per running foot.

The only objection raised in the discussion on this work was the deterioration which cast-iron undergoes when in contact with salt-water.

The first parts of the light-house were landed at Bermuda about the end of November 1844; the first plate was erected on Gibbs' Hill on the 19th December 1844; and the last plate of the tower on the 9th October 1845. Time, one year. Cost, Rs. 95,000.

#### THE USHRAFFEE LIGHT-HOUSE.

This light-house is situated in the Red Sea, in the Straits of Jabel, 150 miles from Suez, and is founded on the Coral reef, against whose danger it serves to warn passing vessels. Commencing at the foundation, the material for the piles was the first matter for consideration. The choice lay between cast-iron and timber, but as cast-iron is of so uncertain durability in sea water, it was determined to use teak of the best quality as possessing the following advantages:—

- (a) less cost by one-third;
- (b) less weight by one-half for the men to handle when working up to their waist in water;
- (c) buoyancy in the water, thus facilitating discharge from the ship and moving from place to place at the work;
- (d) facility for accurate adjustment after being fixed in place.

Teak was therefore chosen for the piles with an arrangement by which any pile can be removed and a new one inserted without disturbing the superstructure.

The piles are 18 feet long and 18 inches diameter; they are arranged in two concentric circles, the inner one, 15 feet diameter, consisting of six piles, the outer one of six pairs of piles, the piles of each being 6 feet apart. The outer circle is 39 feet diameter at the heads of the piles, and the feet spread outwards at a batter of  $\frac{1}{12}$ . The piles stand with their feet upon the surface of the reef, but from the height of 4 feet from the bottom they are flattened on each side, the flattened part terminating in a shoulder, under which on each side is placed a sleeper of teak.

The whole area of a circle around the piles, 47 feet diameter, is filled to a height of 5 feet with concrete, which is rammed under the sleepers so as to relieve the feet of the piles from the superincumbent weight. The concrete is enclosed by a caisson of boiler plates  $\frac{3}{8}$  inch thick, set on edge and bolted and rivetted together.

The heads of the piles pass through a circular wrought-iron collar 18 inches deep, to which they are accurately fitted, and any loosening by the shrinking of the timber is provided for by fitting a number of wedges of green heartwood into corresponding grooves in the pile-heads to which they can be driven down when slack.

A direct bearing surface is also given by iron screws 2 inches diameter which pass through each collar and enter 2 inches into the wood. The collars have projecting arms, which are rivetted to a system of framing, and two raking piles are introduced with a view of checking any possible tendency to a rotatory motion in the structure.

The framework of the superstructure consists of a repetition of three main parts which may be called respectively standards, cills, and radiators.

Each tier consists of 24 standards, 12 in each circle, connected at the top and bottom by cills forming two concentric 12-sided polygons and the corresponding angles of the polygons are connected by the radiators.

With the exception of a few of the parts near the bottom, no separate piece exceeds in weight above 4 cwt.,



so that the whole can be lifted by quick-acting tackle to be easily carried about from place to place by two or three strong men.

The floors of which there are five, consist of cast-iron plates  $\frac{1}{2}$  inch thick, resting upon the lower flanges of the cells and covered with 6 inches of concrete. Additional support is given to each of the floors, except the lowest, by two wrought-iron beams rivetted to the standards under them. From the lowest floor is suspended a water-tank capable of holding about 1,500 gallons of water.

It is difficult to arrive at a definite sum representing the cost of the light-house, inasmuch as material and staff had to be carried and taken from Alexandria, Cairo, and Suez to the site of the light-house, while frequent delays and omissions on the part of the Egyptian officials helped to swell the cost. The *Daedalus* light-house, which, though smaller, is constructed upon an exactly similar plan and was built at the same time as the *Ushrafee*, and their combined cost was £55,211, though, deducting cost of steamers, &c., the actual engineering works cost only £32,079. The *Ushrafee* light-house is 144 feet high and the *Daedalus* 76 feet. Cost per running foot £32,079 ÷ £220 = £146 = Rs. 1,900 per running foot.

The discussion at the Institute of Civil Engineers turned principally upon the substitution of teak for iron columns. It was urged in defence that though teak was liable to be attacked by *Teredo navalis*, yet cast-iron would certainly deteriorate under the influence of salt-water; wrought-iron was objected to on account of its liability to corrosion, unless the pipes were made very thick.

The cost was greatly enhanced by the difficulties of transport and the necessity of carrying out the work from a steamer and by small boats to be set up in water. Eliminating these peculiar expenses, the *Ushrafee* is put down as costing £22,000 or nearly 2½ lakhs.

In regard to time, within 10 months of the Engineer receiving his instructions he surveyed the sites (3,000 miles from England): sites were approved: contracts made: drawings, &c., made; materials manufactured, erected, taken down, and despatched to Egypt.

The working parties left Egypt on the 6th November 1881: on the 6th January foundations finished: on the 5th April tower built to lantern-level: May and June, lantern fixed and all finished.

Time, say, one year of work. Cost, Rs. 2,20,000. Height, 144 feet.

### TURN-OUTS OF EQUAL RADII, WITH STRAIGHTS BETWEEN THE REVERSE CURVES.

SOME years ago the writer had to set out a large number of diversions round unfinished culverts on a line of Railway in India. His attention was thus turned to obtaining a simple but correct method of setting out reverse curves, with "straights" between. The method now described dispenses with the use of angular and drawing instruments: three poles and a measuring tape being all that is necessary. The calculations being done on the ground.

Given

$d$  = Distance apart of the two parallel lines to be connected, viz., K K and Q Q = E D

$R$  = Radius of connecting curves

$S$  = Straight necessary between curves = J H

Required

$L$  = G E = distance from G\* to the beginning of the curve on the main Line

\* Note. — G, G\* Convenient distances on each side of the centre of the culvert fixed by practical consideration not pertaining to the problem in hand.

And  $T = E F = F H = B N = N J$

The following is the solution

$$G E = L = \sqrt{S^2 + 4Rd - d^2} \quad (1)$$

$$E F = T = \frac{Rd}{S + L} \quad (2)$$

Example.

If  $d = 30' = .3$  chain

$S = 50' = .5$  chain

$R = 1000' = 10$  chains

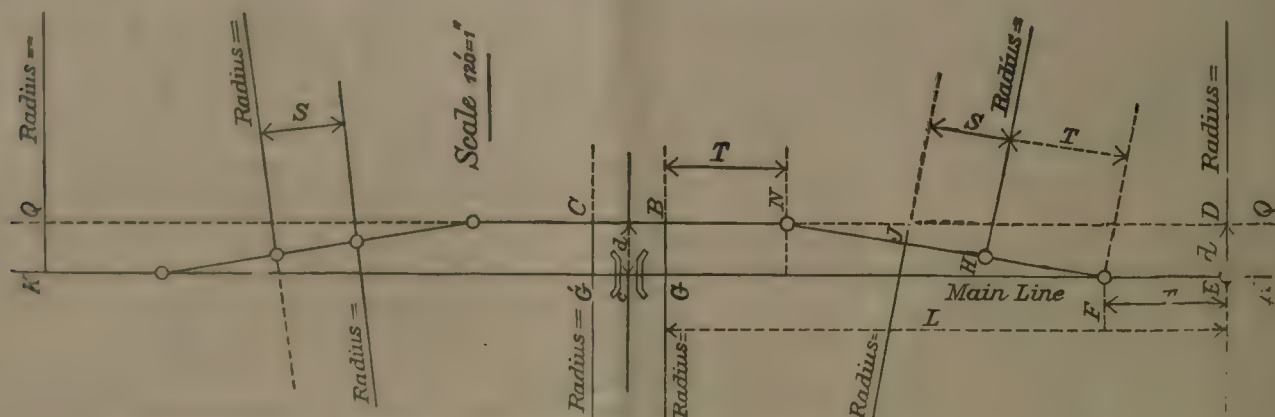
Then  $L = \sqrt{.25 + 12 - .09} = \sqrt{12.16} = 3.487$  chains = 348.7 feet.

$$T = \frac{40 \times .3}{.5 + 3.487} = \frac{3}{3.98} = .753 \text{ chains} = 75.3 \text{ feet.}$$

The problem of finding  $T$  and  $L$  where the two lines are inclined to one another is one which Mr. Ewbank, I have no doubt, would like to tackle. I have not seen the formulæ (1) and (2) in any book I have come across, I haven't seen a very late edition of Mr. Cole's book, and they may be in it now.

Govindgarh, Patiala State; }  
September 26, 1888.

R. L. CAMPBELL.



### The Gazettes.

#### PUBLIC WORKS DEPARTMENT.

Burma, October 27, 1888.

The following Assistant Engineers, 2nd grade, appointed by Her Majesty's Secretary of State for India in Council from the Royal Indian Engineering College, who have gone through a course of practical training in England, are posted as follows:—

To Burma.

Mr. Arthur Gordon Rose Trapmann.  
Mr. Harry Cecil Jouca.

Mysore, October 27, 1888.

Mr. T. Inman, Executive Engineer, is appointed to the charge of the Bridge Division, which has been formed from the 13th September 1888.

Madras, October 30, 1888.

The following promotions are made:—

Colonel H. Smalley, R.E., from Superintending Engineer, 3rd class, temporary rank, to Superintending Engineer, 2nd class, temporary rank, with effect from 10th October 1888.

Mr. W. Hughes, B.A., from Executive Engineer, 2nd grade, to Superintending Engineer, 3rd class, temporary rank, with effect from 10th October 1888.



M. R. Ry. S. Gopala Krishna Aiyar Avergal, Rai Bahadur, A.C.E., from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 10th October 1888.

Mr. J. P. Davidson, Executive Engineer, 3rd grade, is granted furlough for fifteen months from or after 16th November 1888.

The following appointment is made :—

Mr. A. A. G. Malet, Executive Engineer, 4th grade, temporary rank, to be Assistant to the Chief Engineer for Irrigation and Under-Secretary to Government, Public Works Department Irrigation Branch, with effect from date of joining on Mr. J. P. Davidson's departure on furlough.—To join at the public expense.

The following intimation, received from the Secretary of State is published :—

Mr. H. H. O'Connell, Assistant Engineer, 1st grade, Madras, is permitted to return to duty within period of leave.

The following posting is ordered :—

Mr. H. H. O'Connell, Assistant Engineer, 1st grade, to the 2nd Circle, for charge of the Nellore Division.—To join on return from furlough.

The following transfer is ordered :—

Mr. T. W. S. Smyth, Assistant Engineer, 2nd grade, from the 1st Circle, Rushikulya Division, to the 6th Circle, Madura Division.—To join at the public expense.

The following promotion is made :—

Honorary Lieutenant and Deputy Assistant Commissary J. Nicholson, from Sub-Engineer, 1st grade, to Assistant Engineer, 1st grade, permanent rank (Superannuated), with effect from 18th May 1888.

The following transfer is ordered :—

M. R. Ry. S. Ramayya Pantulu, Overseer, 2nd grade, from No. V. Party, Tank Restoration Scheme, to the I. Circle, Ganjam Division.—To join on return from sick leave.

#### India, November 3, 1888.

The Governor-General in Council is pleased to order the following promotions of Executive and Assistant Engineers, attached to State Railways, with effect from the dates specified :—

Mr. R. C. Beeston, from Executive Engineer, 2nd grade, sub. *pro tem.*, to Executive Engineer, 2nd grade, permanent rank, with effect from 1st June 1888.

Mr. G. V. Martyn, from Executive Engineer, 2nd grade, sub. *pro tem.*, to Executive Engineer, 2nd grade, permanent rank, with effect from 1st June 1888.

Mr. R. W. Egerton, from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 28th August 1888.

Mr. E. E. A. Küster, from Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 4th grade, permanent rank, with effect from 30th August 1888.

Mr. A. S. Trevor, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 30th August 1888.

Captain G. F. Wilson, R.E., from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 1st September 1888.

Mr. E. E. A. Küster, from Executive Engineer, 4th grade, to Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 1st September 1888.

Mr. I. R. Tickell, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 19th September 1888.

Mr. E. F. Gordon, from Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, sub. *pro tem.*, vice W. Michell, on furlough, with effect from 19th September 1888.

Baroda Prosad Bosu, Rai Sahib, from Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, sub. *pro tem.*, vice W. S. Haig, on furlough, with effect from 19th September 1888.

Mr. E. H. Tuck, from Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.*, vice F. Reilly, on furlough, with effect from 19th September 1888.

Mr. A. R. Macdonald, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, sub. *pro tem.*, vice W. Chadwick, on furlough, with effect from 19th September 1888.

Mr. G. Moyle, from Executive Engineer, 3rd grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, permanent rank, with effect from 28th September 1888.

Mr. W. Wiseman, from Executive Engineer, 2nd grade, to Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 2nd October 1888.

Mr. H. H. Gaham, from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 2nd October 1888.

Mr. H. Irwin, C.I.E., Executive Engineer, 1st grade, Superintendent of Works, Simla Imperial Circle, is appointed to officiate as Superintending Engineer and Secretary to the Agents Governor-General for Rajputana and Central India, in the Public Works Department, during the absence on leave of Major G. F. L. Marshall R.E., or until further orders.

Mr. M. C. Mackinnon, Executive Engineer, 2nd grade, State Railways, is transferred from the Establishment under the Director-General of Railways to that under the Government of Bengal.

The services of Mr. J. W. Parry, Assistant Engineer, 1st grade, State Railways, are transferred from the Establishment under the

Director-General of Railways to that of the Government of Bengal for employment on the Western Bengal Surveys.

Lieutenant-Colonel Henry Wilberforce Clarke, R.E., is re-appointed to the Public Works Department as officiating Deputy Consulting Engineer to the Government of India for Railways, Calcutta, with the rank of Executive Engineer, 1st grade.

#### N.-W. Provinces and Oudh, November 3, 1888.

##### Irrigation Branch.

Mr. H. M. J. Bacon, Assistant Engineer, 1st grade, Northern Division, Ganges Canal, is transferred from the 1st to the 3rd Circle, Irrigation Works.

Mr. J. R. C. Nicolls, Assistant Engineer, 1st grade, is, on return from furlough, posted to the Cawnpore Division, Lower Ganges Canal.

#### Central Provinces, November 3, 1888.

##### Establishment.

With reference to Public Works Department Notification, dated the 25th October 1888, Mr. D. Wallace, Executive Engineer, 1st grade, made over charge of the Eastern Division to Rai Sahib T. N. Mukhopadhyay, Assistant Engineer, 1st grade, on the forenoon of the 29th idem.

#### Bengal, November 7, 1888.

##### Establishment.

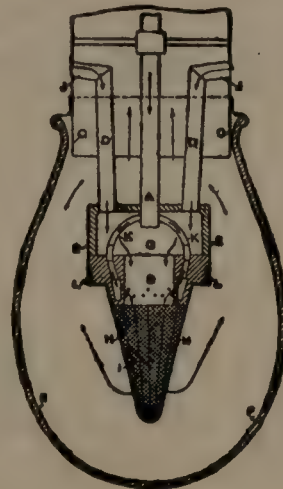
Rai Haran Chunder Banerjee Sahib, Executive Engineer, is re-transferred to the Office of the Superintending Engineer, Western Circle, with effect from the 8th October 1888.

Mr. A. H. Mason, Executive Engineer, 4th grade, temporary rank, is transferred from the Eastern Bengal State Railway to the Western Bengal Railway Surveys.

## Indian Engineering Patent Register.

### RECENT BRITISH PATENTS.

INCANDESCENT GAS BURNERS.—*J. Imray, London. (C. Clamond, Paris.)*—The present invention relates to the construction of burners in which a gas flame supplied with hot air heats a network of magnesia. Instead of using magnesia alone, the present inventor mixes 20 per cent. of zirconia with it. The hood may be placed either above an ascending gas flame, or in an inverted position below a descending flame. When the hood is used in an inverted position, as for a ceiling light, the burner is constructed as shown in vertical section in the accompanying figure. The hood I is suspended in a net H of fine platinum wire,



which is attached by a bayonet catch to the ceramic burner L. The gas supplied by the pipe A is led by several tubes K into the annular space in L, whence it issues through numerous small holes directed radially inwards in the burner B. The hood E, resting on the burner L, encloses a chamber G, into which the tubes D open; air enters at the upper mouth J, and passes into the chamber G. A glass globe F suspended from the chimney encloses the burner; the draught of the chimney causes air to enter and descend the tubes D, where the air becomes heated. Four claims are made for the addition of zirconia to the material employed in the hood, and for the several constructions of lamp described.—No. 7990. 2nd June 1887.

## Advertisements.

### WANTED.

A SITUATION as P. W. Inspector on construction or on an open line of Railway. The undersigned has had considerable experience in bridge and construction work; he has been on an open line for the past six years; his services are now being dispensed with owing to a reduction in the department.

Apply to—

J. T. ROBINSON,

P. W. INSPECTOR,

KARCHANA,

(N. W. P.) E. I. Railway.



D. P. W. India.

**IMPORTANT NOTICE.**

All Civil Engineers of the Department are informed, that, owing to the extended support accorded to the Civil Engineers' Association, the Committee feel it necessary to still further widen their sphere of influence, and to delegate some of their duties.

The current work has been entrusted to Local Sub-committees, who will correspond with the Central Committee.

Every Civil Engineer is urged to write to the Hon. Sec. c/o Grindlay, Groom and Co., Bombay, who will put him in touch with his Sub-committee, with the view of enrolling him a member of the **Civil Engineers' Association.**

**WANTED.**

**E**NGAGEMENT as Draftsman and General Assistant in an Architect's or Engineer's Office. Excellent testimonials.

Address—A. B.—

c/o EDITOR,

*Indian Engineering.*

(197)

**WANTED IMMEDIATELY.**

**A** COMPETENT TELEPHONE INSPECTOR for H. H. the Nizam's Telephone Department. Salary H.S. Rs. 150 and Rs. 30 Horse Allowance. Applicant should state age, nationality, whether Married or Single, and furnish copies of Testimonials addressed to

**D. GAUNTLETT,***Officiating Chief Engineer and Secty.**to Government, P. W. Dept.*

HYDERABAD, DECCAN, }  
October 19, 1888. }

**THOMSON & MYLNE'S****PATENT SUGARCANE MILLS.**

For particulars of Depots, Licensees, &amp;c., address—

**THOMSON & MYLNE,**

BEHEEA, E. I. RAILWAY;

or 6, Commercial Buildings, Calcutta.

(103)

**EAST INDIAN RAILWAY.**

*Sale of surplus and condemned stores comprising crepsoting or timber preserving apparatus, anchor heavier boat and jolly boat, old section iron fishplates, new section spikes, plate glass, second-hand second class deodar and sdl sleepers, incomplete rail presses, stone-ware pipes, scrap india-rubber, scrap glass, scrap cast and wrought iron, scrap steel, zinc, and brass, mixed metal borings, old iron and steel rails and crossings, wrought iron skeleton wheels and axles, steel scrap springs and tyres, shop sweepings, firewood sleepers, miscellaneous firewood, &c., &c., &c.*

Tenders will be received at the office of the Controller of Stores, East Indian Railway Company, Fairlie Place Calcutta, up to noon of Thursday the 29th November, 1888, for the purchase of surplus and condemned stores as above at Howrah, Rampore Haut, Asansol, Jamálpur Sahebgunge, Dinapore, Allahabad, Cawnpore, Aligarh and Gháziabad.

Tenders must be submitted in the form to be obtained at the office of the Controller of Stores, where printed lists of the stores can also be had, and tenders submitted in any other way will not be considered.

The various lots are open to inspection by intending purchasers on application to the Store-keepers in charge of the depôts where the stores are respectively located.

**D. W. CAMPBELL,**

Calcutta, 5th Nov. 1888.

*Agent.***CREAT WESTERN HOTEL, BOMBAY.**

[29]

MACHINERY  
CYLINDER  
ENGINEOIL SPINDLE  
BATCHING  
LUBRICATING

Stocks of all descriptions always in hand. Contracts at reduced rates.  
(134) **KER DODS & Co., 81, Clive Street.**

**ROOMS WITH BOARD, BY DAY OR MONTH.****MRS. OGILVIE,**

46, WELLESLEY STREET,  
CORNER OF PARK STREET,  
CALCUTTA.

**E. T. C. BLEND  
HIGHLAND WHISKY.**  
Rs. 25 per dozen.

**GISBORNE & CO.,**  
(193) **40, STRAND.**

**A GREAT WANT SUPPLIED.**

No Package Genuine  
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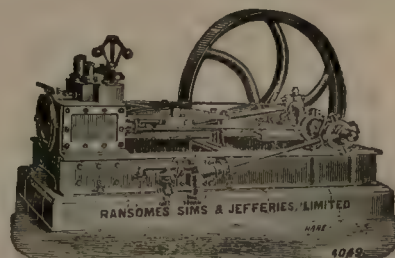
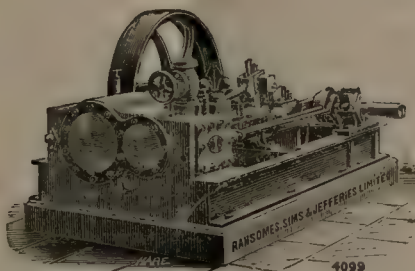
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### NOTICE.

SEALED TENDERS will be received by the Municipal  
Commissioner for the City of Bombay, up to 2 P.M. on  
Monday, the 17th day of December 1888, for the supply of  
Fittings and Service Pipes required for Water Works purposes.

2. Form of Contract, Specification, &c., and all information  
can be obtained on application to the Undersigned, on payment  
of Rs. 5.

3. Tenders should be accompanied by a Deposit of  
Rs. 5,000, to be paid to the Chief Accountant in Cash, and  
to be forfeited in case of refusal to sign the Contract.

4. The Municipal Commissioner does not bind himself to  
accept the lowest or any Tender.

By Order of the Municipal Commissioner,

S. TOMLINSON, C.E.,

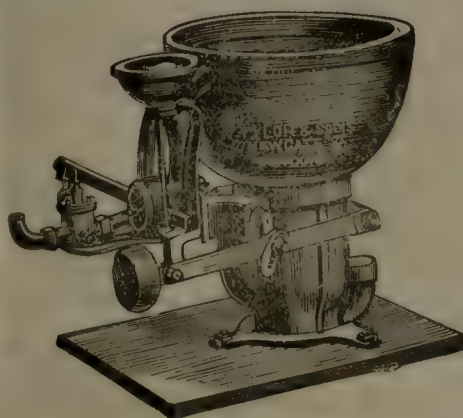
DEPUTY EXECUTIVE ENGINEER,

In Charge Water Works.

BOMBAY; EXECUTIVE ENGINEER'S OFFICE, }

October 17, 1888.

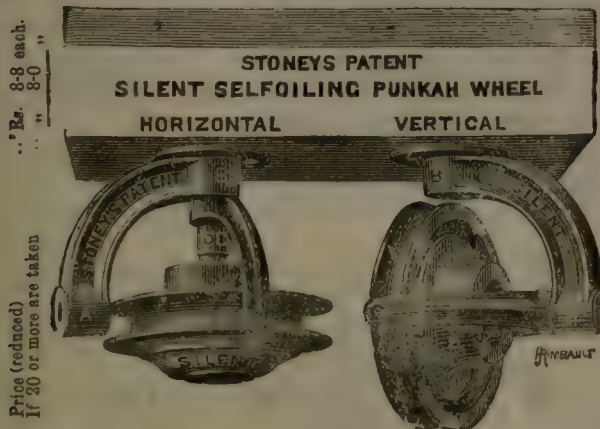
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rope to be pulled off them, are easily fixed in any position, answer equally well as  
Vertical or Horizontal wheels, and run perfectly for years without attention.

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Cast-iron Socket Pipes, of ordinary dimensions, coated with Dr. Angus Smith's solution, and tested up to a pressure of 250 feet of water	Rs. 4-4 per cwt.
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Cast-iron Bends, Tees and Cross Pieces for Pipings of ordinary dimensions coated with Dr. Angus Smith's solution from	7-0 " upwards.
Cast-iron Fire-bars, Floor-plates, Plain Columns, &c., from	5-0 " "
Cast-iron Railway Chairs and Railway Sleepers from	3-8 "
Cast-iron Ornamental Columns, railings, gates, spiral staircases, porticos, brackets, arch-fillings, &c., in great variety	At cheapest rates.
Cast-iron Rammers, Road Rollers Garden Rollers, Sugarcane Rollers, Rain-water Pipes, Axle-boxes, parts of machinery and other castings of any description	At cheapest rates.
Water-lifts ... from Rs. 35-0 each, and upwards.	Foundry Pig Iron No. 1 ... 45-0 per ton.
Ploughs ... Rs. 4-0 each.	Ditto No. 2 ... 42-8 "
	Ditto No. 3 ... 40-0 "

Remarks.—Special quotations for large orders. Designs of Ornamental Castings of any description can be had on application. Orders to be addressed to the SUPERINTENDENT from whom any further particulars can be ascertained.

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## THE INDIA RUBBER, GUTTA PERCHA, & TELEGRAPH WORKS Co., Ltd.,

GOVERNMENT AND RAILWAY CONTRACTORS,

MANUFACTURERS OF

VULCANIZED INDIA RUBBER

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(168)

Telegraphic Address—"SILVERGRAY," CALCUTTA.

## COMMERCIAL UNION ASSURANCE CO., LD.

Extracts from the Twenty-sixth Annual Report viz. for the year 1887.

## FIRE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£769,265 0 0
Interest ...	£ 19,612 0 0
Losses after deducting Re-insurances ...	£443,587 0 0

## LIFE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£125,559 0 0
Interest and Dividends ...	£ 45,649 0 0
Claims less Re-insurances, ...	£ 79,229 0 0

## MARINE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£175,118 0 0
Interest ...	£ 8,294 0 0
Losses after deducting Re-insurances ...	£138,365 0 0
Interest not belonging to above, but included in Profit and Loss ...	£ 18,545 0 0

The Life Fund was increased during the year by £65,648 and now amounts to £1,070,064.

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the uncalled Capital of £2,250,000.

The rates of Premium are moderate, but they are not unsafely low, and will be found to stand the test of time, thereby in conjunction with the ample Funds affording absolute security to the assured.

The Total Funds and property in hand on 31st December 1887 stood at £2,613,059.

(39)

C. H. OGBOURNE, Manager and Underwriter.

## PURE HYDRAULIC LIME.

FREE FROM ADULTERATION.

Numerous favourable certificates of the quality of our manufacture have been received, and the following are fair selections:—

J. H. APJOHN, Esq., Superintending Engineer, Kidderpore Dock Works, says:—

"Mr. McKennie's test for purity applied at Ranegunge shewed that it contained only 22 per cent. of insoluble matter, or only 3rds of the impurity allowed; there can be no question but that it is of very superior quality."

PAUL DESJOUX, Esq., Executive Engineer, Government Cement Experiment Division, reported:—

"It is the best Ghooting Lime imported into Calcutta."

JAMES KIMBER, Esq., M.I.O.E., Engineer to the Corporation of Calcutta, says:—

"It has been for long past and is now invariably used in all works, particularly drainage works. I have much pleasure in certifying to the excellent and reliable quality of the Lime."

O. A. MILLS, Esq., Executive Engineer, P. W. D., 2nd Calcutta Division, says:—

The Ghooting Lime manufactured by Messrs. Burn & Co. is better than any that can be purchased in Calcutta. I have used it in the construction of many public buildings and have been thoroughly satisfied with it."

N.B.—Our Lime was used throughout all the River Works of the Calcutta Port Commissioners.

## BURN & CO.,

(179)

7, Hastings Street, or Ranegunge.



## Notices.

The Office of Publication of Indian Engineering is at the "STAR PRESS," 19, Lall Bazar, Calcutta.

General correspondence, and all communications bearing upon literary matters, should, as heretofore, be addressed to PAT. DOYLE, C.E., Spence's Hotel, Calcutta.

It is particularly requested that all letters on business concerning subscriptions and advertisements be addressed to the "Managing Agents," MESSRS. BALMER, LAWRIE & Co., 103, Clive Street, Calcutta; and all remittances be made payable to them.

### Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	Rs. 12	Rs. 7	Rs. 4
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### NOW READY.

## "Artesian Borings in the Sunderbunds."

As the issues of the journal containing the articles headed as above are out of print, and sufficient inducement having offered, the matter has been reproduced in pamphlet form to meet the requirements of District Officers and others in Bengal and elsewhere.

Price Rs. 2 per copy.—Cash.

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## Obituary.

McLEOD—November 1st, at Roorkee, Captain D. McLeod, late of the Engineer Establishment, P. W. D. aged 69 years.

# INDIAN ENGINEERING.

SATURDAY, NOVEMBER 17, 1888.

## OURSELVES.

WE have a large mass of communications, many of them on Service questions, which we find it impossible to print owing to our limited space, and the only way to meet the difficulty and to do that justice to our contributors which we desire, would be by increasing the number of our pages, which our low rate of subscription, the cheapest perhaps in the world, will not permit.

Under the circumstances we solicit an expression of the wishes of our subscribers. *Prima facie* an increased rate of subscription, namely, Rs. 18 per annum, which would still be cheaper than the opposition Journal, would meet the case.

## ANOTHER SCANDAL.

MAJOR H. W. CLARKE, R.E., has just been re-appointed to the Public Works Department, as an Executive Engineer 1st grade. Will some of our correspondents inform us in what year this Officer left the Department? What was his grade when he left? And his length of service at that time? Also, whether he has ever held charge of an Executive Division, and what were his previous services in the Department? The present Classification List does not shew any of the above, as this officer was not on the strength of P. W. D.

We are told that the Department is in excess of requirements, and reductions must be made in the interests of the country. Here is a senior officer brought in, and we would like to know the reason why? On receipt of the information required, steps should be taken to place this appointment before the notice of home authorities and the public.

## BOMBAY MUNICIPALITY.

THE Bombay Municipality's Administration Report, issued under Mr. Ollivant's *imprimatur*, informs us, *à la mode* Sir Oracle, that, "as anticipated," fair progress was made by Messrs. Walsh, Lovett, Mitchell & Co. on the (undefined) duct contract, although, &c., &c. For the current season there is promise of good work to come. Whereas last year only one set of compressed air machinery was in work at one of the tunnels, this year there will be five. So that although only 1,750 lineal feet of tunneling was finished last year the increased power brought to bear on the work will now yield correspondingly increased results. And besides, progress made during a first working year, a year of initiation, obviously must not be taken as the fixed measure of progress to be made afterwards. The earthwork on the syphon sections has made very good progress. The year's masonry work amounted to 1,541,021 cubic feet, which, added to the work done previously,—592,662 cubic feet,—gives a total outturn of 2,133,683. Excavations for foundations, in many places,



had to be carried to a much greater depth than was estimated on the information derived from trial pits, the levels of sound rock sufficiently free from faults or fissures for founding upon being most capricious and irregular. Of course this means revised, increased estimates; but under the circumstances we do not see that any blame attaches to the miscalculation. Somebody is to blame though for not securing the land necessary for them before the works were initiated. As they approach the island of Bombay landowners are taking advantage of this omission, and demanding extortionate prices for their property.

The Tulsi Lake overflowed on the 25th July 1887, and the Vihar Lake commenced to overflow on the 28th August. This early overflow was chiefly due to the unusually heavy rain in the week ending 9th July 1887, 27.89 inches being gauged at Vihar and 25.43 at Tulsi. The work of replacing the puddle trench in the waste weir at Vihar by concrete, and repitching dam No. 2 and extending the puddle trench in that dam were commenced at the close of the year, and they will therefore be referred to in the next year's report. The leakage which rendered these repairs necessary was computed as follows—Leakage from Waste Weir, 1,250,000 gallons; leakage from dam No. 2, 200,000 gallons; total daily loss, 1,450,000 gallons. The filter beds at Vihar, which were completed in 1886, were at work throughout the year, and gave satisfactory results so far as their capacity extended. They are, however, only designed to be capable of efficiently dealing with about one-quarter of the water which is now drawn through the 24" Vihar main. On the 5th July there was a landslip on the Gibbs Road, near the entrance to the Towers of Silence; it carried away a portion of the said road, containing the 24" Tulsi main, and the Gibbs Road 9" main. Repairs were effected, with praiseworthy smartness, in four days. As to that matter the Municipal Commissioner writes:—"I was very favorably impressed with the activity of the Engineering Department in the repair of this landslip." The work, it seems, was not only started immediately after the accident, but carried on by relays of laborers night and day. It cost Rs. 5,268. A portion of the 24" main embankment between Golibar and Bandra had also to be repaired. Over twelve miles of new mains were laid down during the year. *Apropos*, during the year twenty-four additional Inspectors were appointed for detection of water wastage. The game is said to have been worth the candles; has resulted, since 1886 in a saving of 2,282,529 gallons of water per day, most of it brought about by discovery and repair of a large number of leaks from mains, service pipes, and fittings. But for this saving it would have been impossible to supply Bombay's rapidly increasing demands. As it is, even Mr. Ollivant fears that he will be obliged to limit supplies.

Bombay's rapidly increasing population is dwelt upon over and over again in the course of Mr. Ollivant's report. Nevertheless, we are told that it is a question whether building is not being overdone, and a prospective reaction is hinted at. The Jacob fountain was finished during

the year, and is described as a very handsome addition to the ornaments of the city. It is of Jeypore marble. A small-pox hospital was built during the year, with reference to which we are told that "the compound being low-lying ground will eventually have to be filled in." Meanwhile, smallpox patients take their chance of fever and ague. A Fire Brigade Station has been built in the Tardeo District on contract. By contract also was the Nesbit Bridge constructed by the Railway Company. By contracts also is the iron needed by the Municipality obtained now, with favorable results financially, for the Iron Foundry Department of the Civil Workshops had been working at a loss for years before it was closed in 1887. In other Departments the Workshops' account shews a profit. That so far satisfactory result notwithstanding we are glad to find Mr. Ollivant contemplating total abolishment of the Workshops. The sooner he does so the better. He admits that the local firms undertaking all classes of work have greatly increased in efficiency of late years, and we see no reason to suppose that they do not turn out quite as good work as the Municipal Workshops. Under such circumstances there is no excuse for arbitrary interference with the free action of trade and Mr. Ollivant admits that if he went into the open market for what he wants much "friction" would be avoided, as well as some money saved, and a good deal of infructuous labor spared to the Engineering Department, if relieved from the burden of accounts and correspondence. Why then delay, and dilly dally over an admittedly useful reform? How does it happen that Bombay, "*urbs prima in Indis*", as the ducks are fond of calling it, is admittedly poorly lighted?

#### FORESTRY IN ASSAM.

THE Assam Government's Resolution on the last provincial forest report submitted (1887-88) characterizes it, or rather the tale of work it summarizes, as "eminently successful and satisfactory." Mr. Mann was in charge of the department for best part of the year—with the exception that is to say of 2 months and 28 days, during which Mr. Jellicoe officiated for him. 603 square miles were added to the forest reserve area; natural boundaries were substituted for artificial ones; the best cash balance shewn for many years was exhibited. Para. 10 is of sufficient importance for verbatim reproduction. It runs thus:—

As regards reproduction, the Chief Commissioner agrees with the Conservator in thinking that, especially in the present state of our finances, it will be best to restrict ourselves chiefly to the careful protection of the growing stock, which for some generations to come will be sufficient to meet all demands, and not to attempt artificial reproduction on any large scale. In paragraph 7 of the orders on last year's report, the Government of India suggested the desirability of trying the effect of improvement cuttings with a view to facilitate the regeneration of the more valuable kinds of trees by the removal of inferior species. In order to give effect to this suggestion, the Conservator has, since the close of the year under report, directed the experiment to be tried in the



Cachar and Sylhet Divisions, free permits or permits at reduced rates being given for the purpose, and the cutting being carried on under the supervision of subordinate officers of the Forest Department. In the Assam Valley the Conservator reports that the demand for the inferior kinds of timber and of firewood is as yet so small and the value so low that wood-cutters would probably not be found willing to make such clearances without special payment. Mr. Mann has, however, called for reports on the subject, and the Chief Commissioner will await the result of these enquiries before deciding what action (if any) should be taken in the matter.

Assam forests in short are suffering from *malheur de richesse*. It is a parlous condition, and its lazy *laissez faire* inclinations ought always to be kept in mind, and guarded against.

Perhaps the most important feature in the report is the increase in demand on the forests in the Assam Valley and Hill districts for *sdl* timber. In 1886-87 it was 188,361 cubic feet; in the next year it had mounted up to 333,638 cubic feet. There would seem to be ground for expectation that the causes inducing this extra demand are of a permanent character. The local Government and the Department cannot agree as to the causes that have brought about an increase in the demand for second class timber, outturn of which increased during the year under review from 367,343 cubic feet to 1,021,674 cubic feet. The Department attributes the gain to a run on its stores for material for tea chests. A supercilious Secretariat professes to consider this "too good to be true."

Here is the crux of Forest Officers' difficulties in Assam, out of the uncertain mouth of the Chief Commissioner of that Province. He says dubiously "Next to the paramount object of conserving our forests for future generations comes that of working them as profitably as possible for the benefit of the present generation; and the peculiarity of this Province, where the exuberance of nature exceeds even the wastefulness of man, is that the latter object is in most parts by far the more difficult of the two to secure. The difficulty which would, even under other circumstances, be great, is enhanced by the fact that, owing to the position the ryots have established in relation to the forests, we are deprived of the most important market for our forest produce. Whatever pains we may take to render it clear that the concessions we now make to the ryots are revocable at pleasure, we cannot hope, at least in the present generation, to make them pay for what they have so long been accustomed to take almost as freely as the air they breathe, or the water they drink. We shall be practically compelled, *for a long time to come*, to let them have free of charge the minimum of the less valuable sorts of forest produce."

Either is the Government to be a local dead letter or the Department? Either one conclusion or the other seems inevitable.

We need only add that, on the whole, the quantity of forest produce for which free grants were issued has more than doubled in comparison with the previous year.

## Notes and Comments.

**AN APPOINTMENT.**—Mr. Morris, Executive Engineer, who has some colliery experience, has been placed in charge of the Dundote and Khost collieries, and it is to be hoped he will wake them up.

**THE BURMAH RUBY MINES.**—It is announced in the city that the India Office has decided against the Streeter Syndicate. It is expected that tenders will now be invited to work the Ruby Mines.

**ROYAL ENGINEER OFFICERS.**—It has been ruled that a Royal Engineer Officer, permitted to proceed to Chatham for a course of practice and training, does not interrupt any leave previously earned by him. The time so spent will not count for leave of any kind.

**PERIYAR PROJECT WORKS.**—The progress on this gigantic undertaking, which absorbs the undivided time and attention of a senior Superintending Engineer, who sacrificed a 2nd Class Chief Engineership for the credit of carrying out the scheme, still continues satisfactory notwithstanding unfavorable weather.

**STRANGE IF TRUE.**—A paragraph is going the round of the Press to the effect that the mathematical paper at a late Roorkee Engineering College Examination was set by a young lady, the daughter of a distinguished Military officer at Simla. If this story is true, we are ungallant enough to consider the innovation decidedly *not* a compliment to Roorkee.

**A SUCCESSFUL APPEAL.**—We are glad to notice by a recent notification in the *Gazette of India* that Mr. R. White, Honorary Assistant Examiner, is appointed to officiate as Deputy Examiner of Telegraph Accounts. We believe this is due to an appeal he made to the Viceroy against his supersession on what appeared to be social disqualification, though he efficiently served the State for 30 years.

**MADRAS TRAMWAYS.**—The draft order authorising the construction and maintenance and to regulate the working of tramways in the city of Madras has been published for general information. We there learn that the "Indian Tramways Construction Company, Limited", with a nominal capital of £120,000, divided into 24,000 shares of £5 each, are the "Promoters." We may deal with this subject later on.

**AN ITEM FROM THE NORTH-WEST.**—The Member for P. W. D. and the D. G. R. attended by Colonel Wallace and Messrs. Sandiford and Upcott, are on tour on the N.-W. R. They visited the Bridge works at Sukkur on the 7th, and saw one of the members hoisted, then visited the Loco. Shops and breakfasted with the Commissioner in Sind on his steamer, which is now lying at Sukkur, leaving in the evening for Quetta.

**THE SURVEY FOR THE DELHI, UMBALLA, KALKA RAILWAY.**—Mr. R. A. Way will take up his post as Chief Engineer of this line in a week or two, and will then start a party from the other end to that from which Mr. Graves is working. The construction is to be started as soon as the survey is sufficiently far advanced to admit of such. Messrs. Steel & Co. are the agents, the home firm having financed the undertaking.

**RESIDENCES OF GOVERNMENT OFFICIALS.**—The Governor-General in Council is pleased to lay down the following rules in supersession of all previous orders, for



regulating the rents to be charged for Government buildings occupied as residences by Government officials:—The rent should be a sum which will cover—(a) Four per cent. interest on the actual capital cost of the house and its site. (b) The estimated average annual cost of repairs.

**SUPERFLUITIES IN A GOVERNMENT HOUSE.**—The Government of India came down rather heavily on Lord Connemara, the Governor of Madras, by directing him to pay from his annual sumptuary allowance, the cost of a Racquet Court and a Swimming Bath that he had got erected at a cost of some Rs. 12,000. However, on an humble appeal from the Governor, pleading ignorance of rules, the Government of India let him off with a caution not to do it again.

**A WISE PRECAUTION.**—The Allahabad Municipality, before embarking on the new water-works project for the city, have resolved to carry out an experiment in filtering the Jumna water, to ascertain if it will be fit for drinking. Should the experiment prove successful, the prosecution of the works will be proceeded with immediately, the Local Government having, after much protestation, agreed to lend 10 lakhs, repayable in 30 years, at  $4\frac{1}{2}$  per cent.

**THE MADRAS HARBOUR.**—The Harbour Trust Board have forwarded plans and estimates prepared by their Engineer, Mr. Pogson, for repairing the harbour and restoring it to the same condition as it was before the storm of 1879. The question of the plan of the North-Eastern entrance to be left to the Home Committee for decision. A strong recommendation has been made to the Secretary of State on the Board's proposal to confirm Mr. Pogson in his acting appointment as Engineer.

**A MISTAKE RECTIFIED.**—Borings for oil are to be made at Shoran, a place accessible from the Railway, and for water at Bell Put. There may be good reasons for it, but it seems a mistake to have left a commercial enterprise like this so long in the hands of the Political Department, which according to poor Ali Baba is richer in humbug than even most Government Departments. Certainly the results of about four years' work are not very satisfactory, as they are practically *nil*.

**THE MADRAS LEGISLATIVE COUNCIL.**—Some surprise has been expressed that Colonel Mead, R.E., as Secretary to Government, P. W. D., was not appointed an honourable member of the Legislative Council as his predecessors, Colonels Sankey, Shaw-Stewart and Hasted. The cause assigned is that, as there is no great P. W. D. measure or Bill before the Council, a P. W. D. officer was not necessary, especially as a P. W. D. officer was all at sea regarding everything out of his own Department!

**A PASSENGER TRAIN OVERTURNED.**—The cyclone which recently passed over Madras was disastrous in its effects on the South Indian Railway line near Chingleput. The night train from Madras to Trichinopoly was upset without the assistance of rapid motion on the part of the train—which was approaching the station, and therefore had slackened speed. The only precedent of such capsizing was on the E. I. R. in 1874 or 1875. Marvelous to add none of the passengers were seriously hurt.

**RAILWAY INCOMES.**—The East Indian Railway, although reckoned fourth among the longest lines, returned the largest income earned by any of the longest lines in India during the week ending 19th September. The Rajputana-Malwa Railway, the second largest in length,

earned almost three times less than the East Indian Railway, and the income of the G. I. P. Railway, the third longest line, was Rs. 3 lakhs less; while the N.-W. Railway, the longest line in India, could scarcely boast of one-third of the earning returned by the East Indian Railway.

**A CHANGE FOR THE WORSE.**—The amalgamation of the Punjab and Sind Sections of the N.-W. R. is practically complete, all the Head-Quarter offices having been moved to Lahore, leaving only at Sukkur a District Loco., an Executive Engineer and an Assistant Traffic Superintendent. The net result seems to be that everyone is dissatisfied, practical commentary on the excellent platitude of the Government of India in a recent circular, "to remember the economy of working with a contented staff." One, cannot of course, please everybody, but in this case nobody seems contented.

**EXECUTION OF PROVINCIAL AND LOCAL PUBLIC WORKS IN THE NORTH-WESTERN PROVINCES AND OUDH.**—The Lieutenant-Governor and Chief Commissioner, having had under his consideration the question of the agency by which Local Public Works under the control of District Boards should be executed, has decided that whilst the more important works and repairs requiring professional skill should be entrusted, as at present, to the Public Works Department, petty repairs and minor works may with advantage be directly carried out by District Boards; a small and inexpensive establishment being entertained by them for that purpose.

**APATHY AND INSOUCIANCE OF THE POSTAL AUTHORITIES.**—On a recent occasion the P. and O. Mail Steamer arrived in Bombay twenty minutes after the mail train had started. No special was despatched to catch it up, and consequently the Calcutta public had to wait an extra twenty-four hours for its anxiously looked for home letters. This is by no means the first instance of similar apathy and insouciance on the part of the Postal Authorities—for they are to blame, not the Government, which is willing enough to be obliging in this matter. It is intolerable that perverse Departmental obstruction should be allowed to prevail over its good intentions.

**MADRAS WEST COAST RAILWAYS.**—Lord Connemara is not keen about the construction of Railways in the Southern Presidency. At Tellicherry the other day, replying to a Municipal address, its advocacy of Railway connection between the West Coast and Mysore, and of the extension of the Madras Railway to Tellicherry and Cannanore, he said he feared that unless private enterprise constructed the Railways, there was little hope of their coming into existence at all: the Government could give no help. Again, at Cannanore, His Excellency doubted if the Municipality had sufficiently considered the question whether its proposed extension of the Madras Railway would pay.

**THE HIGHER ENGINEER ESTABLISHMENT.**—The Government of Madras have objected to the Resolution of the Government of India placing all superior officers on one list for promotion, as they consider it was issued without the consent of the Madras Government being first obtained. The objections of the Madras Government to the proposal are:—(1.) That they have always followed a strict system of selection for the higher appointments, and have done nothing to deserve the deprivation of a power they have held for many years. (2.) That the superior posts in the Madras Presidency require officers thoroughly acquainted



with the system of Irrigation Works in Madras, and with a knowledge of the language and people.

**THE COST OF RAILWAYS.**—With respect to the proposed extension of Railways in India, it must be borne in mind that the sterling cost per mile of a first-class railway at the present day is little, if at all, more than half that of the original Guaranteed lines, which were built when Railway plant and material were double the price they are now, and which had to buy the experience necessary to teach Engineers to cope with Indian rivers and floods at the cost, in some instances, of reconstruction two or three times repeated. If the cost of the Madras Railway stood at what they could now be constructed for *de novo*, the net earnings, instead of returning only 2½ per cent. on the capital, would yield a return of 5 per cent.

**COMMONSENSE.**—Mr. McIver, the Manager of the Siam Forest Company, believes in a conjunction of elephants and commonsense for successful forest work "on a broad commercial basis." He has bought thirteen of the former for Rs. 20,000; and a Bombay contemporary informs us, that "with these, and plain commonsense, he yet hopes to get some timber out of the forests, and down to Bangkok." We wish him all success in this endeavour. But what is commonsense? There is not another word in the English language, compound or simple, that has so many different interpretations given to it, the real meaning of which is so little understood. It is scarcely an exaggeration to say that commonsense is the most uncommon of all senses.

**THE REPORT OF THE CURRENCY COMMISSION.**—The final report of the Currency Commission has been published. In it confidence is expressed that if the system which prevailed before the year 1873 were replaced, the majority of the present evils would be removed, the latter being infinitely more serious than the evils which are expected to result from a return to the *status quo ante*. No settlement is possible, however, without international action. The Commission proposes a free coinage of both metals into legal tender money, fixing a ratio whereat the coins of either metal are receivable in payment of debts at the option of the debtor. The Commission also proposes that England should join with America, Germany, and the nations of the Latin Union to restore the bi-metallic system.

**LOCAL FUND PUBLIC WORKS IN THE CENTRAL PROVINCES.**—The Chief Commissioner is now settling the Public Works Establishment on the lines of arrangements already adopted by the Government of the North-Western Provinces so as to provide each district with an Engineer Officer and a suitable staff. These district charges will be Public Works Sub-divisions grouped under a superior officer as Divisional or Executive Engineer. This arrangement will enable the administration to take over the execution of all the public works of the District Council. All the work in the district requiring professional skill can be placed in the hands of the Sub-divisional Public Works Officer. For the execution of all works not immediately requiring professional skill and direction, the Deputy Commissioner of the district with his subordinate staff of all grades will be the responsible executive agency.

**COLOMBO WATER-SUPPLY.**—The repair of the Maligahakanda reservoir is a subject which continues to occupy public attention. The feeling is daily gaining ground in Colombo that Sir John Fowler, however eminent he may

be in his profession, is in this instance going wrong, and that local experience and local experts are much more to be trusted. It is believed that too much stress has been laid by Sir John Fowler on the contraction and expansion theory put forward by Mr. Burnett, which would seem to indicate that Sir John Fowler has been led away by Mr. Burnett, and it is on this ground that the public feel very distrustful of the recommendations made by Sir John. It is suggested that before spending another Rs. 1,40,000 on repairs, it would be well, perhaps, if the Government could be induced to put this expansion and contraction theory to a practical test in a section in the wall, so that the question may be once and for ever set at rest.

**THE WESTERN BENGAL RAILWAY.**—We glean that a beginning will shortly be made with the survey of the proposed Railway from Mogul Serai to the Hughli Bridge. A party of Engineers is now gathering at Madhupur, preparatory to surveying the route, which is intended to be a continuation of the Oudh and Rohilkund Railway from Benares into Calcutta, and is therefore a rival to the "Grand Chord" of the East Indian Railway. The route is from Mogul Serai *via* Sasseram, Gya, Baidyanath (on the E. I. R. chord line), Nya Dumka, Soory, Noni Hat, Ahmedpur (on the E. I. R. loop line), Cutwa, Nuddea, and Culna, to the Hughli Bridge. It will shorten the distance from Mogul Serai to Calcutta by sixty miles, or two hours' running, besides opening up a rich tract of country, and directly connecting the shrines at Benares, Gya, and Baidyanath. This is the usual route for pilgrims between these places, and a large passenger traffic may therefore be counted upon. Two branches have already been proposed in connection with this new line; one from Nya Dumka to Bhagalpur, and the other from Cutwa, *via* Plassey and Moorshedabad, to Bugwangara.

**TRAFFIC DEPARTMENT OF STATE RAILWAYS.**—It is quite time that the steps recently gazetted, were taken to regulate the recruitment of this Department and the progress of the members of it. It is notorious that Government possess a greater number of inefficient servants in the Traffic than in any other branch, not of State Railways alone, but of all services; and that their average emoluments under the incremental scale and impetus of a vacant Department far exceed those of the Cooper's Hill Engineers whose attainments are undeniable. But if Government seriously desire to obtain the services of Engineers in this branch, it is most unfortunate that the impression should have arisen that the posts of Manager and Deputy Manager are to be reserved for R. E's. alone. An impression which is strengthened by the recent action in appointing three R. E's. to the head of the North-Western Railway, displacing Messrs. Rutherford and Lightfoot, who have hitherto, as Managers of the Punjab and Sind Sections, done all the work. Is it probable that if the better paid and more respected posts of the Management are to be reserved for Royal Engineers, that the Civil Engineers, who already grumble at their getting all the plums, are going to occupy the posts that they do not care about? We think the C. E's would do well to stick to their own branch, bad as it may be, for the Traffic is now pretty well filled up, and a young Cooper's Hill man, who transfers himself to that branch, may rely upon remaining an Assistant Traffic Superintendent for the best part of his life, work as hard as he may.



## Current News.

THE Sukkur bridge works have made great progress lately, and the Engineer hopes to open the bridge by March.

THE capital sunk in the filtered and unfiltered water-works of Calcutta up to the end of March 1888, was Rs. 1,22,86,485.

THE Government of India has sanctioned the construction of an extra reservoir for the improvement of the water-supply of Simla.

THE actual amount of Calcutta Municipal funds, sunk in drain-works up to the end of the official year, 1887-88, amounted to Rs. 97,96,724.

THE following Assistant Engineers are posted to the North-Western Railway :—Mr. H. A. F. Currie, Mr. E. C. Herbert, Mr. C. D. D. Wilson.

MR. GEORGE PALMER having resumed his duties as Secretary to Government, P. W. D., the Chudderghant Water scheme may now be expected to make progress.

NONE of the officers of the office of the Director-General of Railways at Simla will come to Calcutta this cold weather, with the exception of the Director-General himself.

GENERAL SIR THOMAS BAKER and the Engineer Officers are busy just now with the details of the defences of Rawal Pindi, for which large sums of money have been sanctioned.

MR. FURNIVALL, the Agent and Chief Engineer of the Nizam's Guaranteed State Railway, is arranging to open the line from Bonakalu to Bezvada for goods traffic very shortly.

SLIGHT rain showers have occurred in parts of the N.-W. Provinces, the central parts of the country, Rajpootana, and Malabar. Elsewhere the weather has been generally fair.

COLONEL PEMBERTON, Secretary to Government of India, Public Works Department, was to have left Simla on the 9th instant for Umballa, and thence to Calcutta on the following morning.

DURING the Madras cyclone the lowest barometric pressure was 28.995, and the greatest hourly wind velocity 46 miles. The gusts were unquestionably stronger than in the memorable cyclone in May 1872.

MR. W. C. FURNIVALL having resigned the Agency of the Deccan Mining Company, Mr. Lewinsky, who had been in charge of the diamond field, has been appointed Agent to the Company in India in his stead.

MR. W. L. DALLAS, Assistant Meteorological Reporter to the Government of India, has returned to Simla from Calcutta, where he was acting as Meteorological Reporter to the Government of Bengal. Mr. Dallas takes charges of the Imperial Office at Simla during the winter.

THE progress of the fortified *serai* at Lundi Kotal, is very marked. The walls are very well forward, and with the abundant supply of local labor furnished by the tribesmen the work is proceeding steadily, though the water-supply is somewhat limited owing to the continued drought.

THE financial condition of the Mandalay Municipality seems to be by no means satisfactory. It is stated that the Municipality intends to raise a loan, and that a banker of Jubbulpore has expressed his readiness to advance a sum of 4 lakhs of rupees, bearing interest at 6 per cent.

THE proposal for utilising as fuel the crude petroleum found in the neighbourhood of Khojak is almost settled. The Chief Engineer of the works is of opinion that a saving of three lakhs on the estimates of the tunnel operations alone will be effected, if the proposition is ratified.

THE Bombay Municipality is to have soon a new building for its Office, opposite the Victoria Terminus. According to the *Times of India*, it will be most convenient and airy and in appearance dignified and imposing. In design, it is very similar to the Manchester Municipal Buildings and Hall.

## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

### THE PRESENT STATE OF THE INDIAN P. W. D., AND ITS PAST HISTORY.

#### III.

SIR,—The notification below may prove of interest to your readers.

#### AMALGAMATION OF CONSULTING ENGINEERS' DEPARTMENTS.

*Notification No. 1194G.*

The following Resolution by the Government of India, Public Works Department, dated Simla, 6th September 1883, is published :—

READ AGAIN—

Letter No. 2308, dated 14th September 1881, from the Government of Bombay.

P. W. D. Letter No. 830 R. E., dated 20th October 1881, to the Government of Bombay.

P. W. D. Letter No. 833 R. E., dated 20th October 1881, to the Government of Madras.

Letter No. 2763, dated 5th November 1881, from the Government of Bombay.

Letter No. 747 R., dated 15th November 1881, from the Government of Madras.

OBSERVATIONS.—In the papers now read again, proposals were discussed for the amalgamation of the officers of the Consulting Engineers' Departments of Madras and Bombay with the Railway Branch of the Government of India. It was recorded, in the event of such amalgamation being carried out, that no officer would be withdrawn from or sent to either Local Governments without their previous concurrence, and that the arrangement would in no way interfere with the present system of control over the Railways under the administrative charge of the Local Governments. The Governments of Madras and Bombay assented to these proposals.

RESOLUTION.—On a review of these proceedings, His Excellency the Governor-General in Council is now pleased to direct that the officers of the several Consulting Engineers' Departments in India be brought on the roster of the Railway Branch of the Government of India, Public Works Department.

2. In order to give effect to this decision, the officers of the Madras and Bombay lists named below will be transferred to the Railway List, and they will carry the appointments in the Graded List they now hold, from their own list to the Railway List. As regards promotion, the officers now brought on to the Government of India List will be promoted *pari passu* with officers immediately below them on the Government of India List, and will be treated as supernumeraries in their Grade or Class for a period not to exceed 2½ years from the 1st January 1884. After the 1st July 1886, those of them who remain will be absorbed into the sanctioned scale as vacancies occur :—

#### MADRAS.

Colonel J. H. M. Shaw-Stewart, R.E., Chief Engineer, 3rd class, Consulting Engineer.

Lieutenant-Colonel C. J. Smith, R.E., Executive Engineer, 1st grade, Deputy Consulting Engineer.

Captain W. H. Coaker, R.E., Executive Engineer, 2nd grade, Deputy Consulting Engineer.

#### BOMBAY.

Colonel H. F. Hancock, R.E., Chief Engineer, 2nd class, Consulting Engineer.

Colonel J. Bonus, R.E., Chief Engineer, 3rd class, temporary rank, and Officiating Consulting Engineer.

Major R. T. Frere, R.E., Executive Engineer, 2nd grade, sub. *pro tem.*, Deputy Consulting Engineer.

Captain H. Pilkington, R.E., Executive Engineer, 4th grade.

3. Colonel Shaw-Stewart holds the personal rank of Chief Engineer, Class III, his post on the Madras Establishment being that of a Superintending Engineer. He will continue on the same footing on the Railway List; that is to say, until he is eventually absorbed in the Chief Engineer Class, the Superintending Engineer's post will be kept vacant.

4. According to the above arrangements, the several scales will be respectively reduced and increased, as shewn below :—

Madras, Bombay, Railway.				
Chief Engineer, Class II.	...	...	—1	+1
Superintending Engineers	...	—1	...	+1
Executive Engineer, 1st grade	...	—1	...	+1
Ditto, 2nd grade	...	...	—1	+1
Ditto, 2nd grade, sub. <i>pro tem.</i>	...	1	...	+1
Ditto, 4th grade	...	...	—1	+1

5. With a view to compensate for the loss of the post of Chief Engineer, Class II., transferred from Bombay to the Government of India List, the second Chief Engineer on the Bombay Establishment will be eligible for promotion to Class II. when he is senior to the senior Class III. Chief Engineer on the Government of India List; the scale of Chief Engineers on the Government of India List being increased by one Class III., and reduced by one Class II. appointment, whenever under this rule the second Chief Engineer, Bombay, holds the rank of Class II. But the rule will not come into effect until the retirement of Colonel Hancock, or



until the date on which the Class III. Chief Engineer now on the Bombay List would, in the ordinary course, have been promoted to Class II.

And to shew how far the Secretary of State's confidence had improved in the years 1883-88 the following promotions were made:—

Lieutenant-Colonel J. M. McNeill, R.E., to Superintending Engineer class over the heads of Superintending Engineers his seniors.

Lieutenant-Colonel C. J. Smith, R.E., from Executive Engineer, 1st grade, to Superintending Engineer, 1st class, 3 steps at once over the heads of 25 men senior to him, in face of Notification No. 1194 G., Simla, 6th September 1883.

Colonel J. Browne, R.E., from Superintending Engineer, 3rd class, to Superintending Engineer, 2nd class, over the heads of 9 men senior to him.

Major W. G. Cumming, R.E., to Superintending Engineer, 3rd class, over the heads of 6 men senior to him, and since to Chief Engineer, 3rd class, over 25 Superintending Engineers.

Lieutenant-Colonel B. Lovett, R.E., promoted to Superintending Engineer over the heads of 30 men his seniors, although half of his nominal service in the P. W. D. was spent in work unconnected with the Department.

Captain Langhame, R.E., who had resigned his appointment, was reappointed in 1882 after 3 years' leave, with one step of promotion, and in 1883 given another step, thus superseding many Engineers who had remained at their posts.

Colonel W. W. J. Wallace, R.E.—

Promoted into Revenue, Class I. grade, 3rd November 1879.

„ Consulting Engineer, Lahore, Rev. I., 2nd June 1881.  
Rev. I. 1st October 1884.

Brought back out of Revenue by special ruling and promoted Chief Engineer, 1st class, May 1887, thus superseding 9 Superintending Engineers.

After 1884, the general feeling of hopelessness in the Department increased with the fall in the rupee, and when this went, in 1886, to below 1s. 4d., it was felt that all the concessions gained (with the exception of the relief to juniors by the regrading the Department) were absolutely illusory.

The Civil Engineers' Association took steps with the view of obtaining the conversion of the 4,000 and 5,000 pensions into sterling at 2s. per rupee, or some minimum rate.

The Secretary of State was appealed to through Members of Parliament and by deputation with the view of obtaining—

- (i)—The application of the same rules as regards pension, leave, and promotion to all European Civil Engineers in the Department.
- (ii.)—Justice and fair dealing in the promotion and appointments in all grades and more especially to the higher administrative posts which do not now exist.
- (iii.)—Such a system of retirement as will ensure a fair and equable flow of promotion so that every man who conducts himself properly, and does his duty to his employers conscientiously can have reasonable hopes of attaining the rank of Executive Engineer, 1st grade, at the end of twenty years' service.
- (iv.)—The honest fulfilment of the promise contained in Circular No. 84 of 6th October 1869, viz., that all Civil Engineers shall be placed "in respect to these emoluments on precisely the same footing as all other officers employed on the same duties."
- (v.)—The fixture of pensions in some certain sum so that a man's income on retirement may not be liable to unknown and unlooked for fluctuations in his old age.
- (vi.)—The entire separation of the Military Works Branch; and a recognition of the Public Works Department, as a purely Civil Department, into which Military men can only be admitted on the same terms as they are admitted into the other Civil Departments.

The whole case was laid before the Earl of Kimberley, H. M. Secretary of State for India, in June 1885, on the above lines, and it was pointed out that the instructions of the Despatch of March 1883 had not been carried out.

To this a reply was received shelving the question and stating:—  
"It need scarcely be added that the Government of India and the Secretary of State in Council will continue to watch the effect of the recent changes which have been made, and will not fail to introduce such further improvements as experience may shew to be desirable." And at the same time declining to interfere with the discretion of the Government of India in the matter of separation of Military from Civil works and of promotions from one list to another.

In 1886 the Royal Warrant of 20th February 1886 was published admitting Royal Engineers volunteering to serve continuously on the Indian Establishment to Staff Corps sterling pensions and the difference between them and their Civilian fellow workers was still further accentuated. This although Lord Hartington had assured a deputation which interviewed him in 1882 that in view of the great loss by exchange the Government of India would not incur any further liabilities in gold.

Owing to frequent changes at the India Office, the Secretaries of State, the Marquis of Hartington, Lord Kimberley and Lord Randolph Churchill, were unable to do more in answer to interpellation on the above and other matters than to reply that when possible, attention would be given to the subject.

In the following year a conference of M. P's. met to consider the case of the Uncovenanted Service generally, and the Civil Engineers entered into the movement and supported the motion by every means in their power. The matter was pressed to a division and a powerful speech by Mr. King, M.P., the leader of the movement, but was negatived by 166 to 55 votes, many members abstaining from voting, and some, such as Sir R. Temple and Mr. F. Maclean, voting with the Government against the measure. This was perhaps unavoidable, as it was made a Government question which left the members of the Conservative party no option in the matter.

In the meantime the Public Service Commission had concluded its investigation and submitted its report.

The principal recommendation regarding the P. W. D. was that it should be divided into two main branches—Imperial and Local—the latter being officered by a less highly trained class than the former and given a lower scale of emolument, while the former consisting of R. E's. and C. E's. appointed from England, were to be given exactly the same rules in every respect. You have lately published the proposals of the Government of India on these services and regret to see that the fair and broad recommendations of the P. S. Commission do not commend themselves to the Government of India who prefer to keep the C. E's. of the Imperial list under a number of admittedly obsolete and unfair rules. This proposal has been brought forward as a proof that the Government of India do not wish to act honestly, and that the specious promises of 1869 were made merely to stop agitation and were never intended to be acted on. I do not myself think this possible, but rather that they were entirely overlooked by the Under-Secretary to the Government of India, who not being acquainted with the working of the Department cannot possibly be aware of the real basis of the problem before him.

I believe that no satisfactory scheme can now be worked out without an open and public conference of members of all classes of the P. W. Department.

VERITAS.

#### LORD REAY.

SIR,—One remarkable feature of the Bombay Governor's policy is his undue partiality for Civil Engineers. Not one R. E. except Colonel Cruickshank (whom he deigned to send from Aden to Belgium to act for only two months as Superintendent Engineer) has he trusted with any responsible appointment of late years. It cannot be, and it is not, that the R. E's. of this Presidency are all unfit: undue favoritism and nothing else is at the bottom of the business. And we C. E's. will certainly suffer this some day. We have consistently asked for fair play and still ask for that and no more.

A correspondent of yours describes Lord R. as "amiable and talented but inexperienced and blundering." He is like a man with a talent for drinking but without experience to enable him to carry his waistcoat full home straight or even nearly so. Intoxicated with the quality and excessive quantity of his talent this amiable gentleman is floundering about in all the Departments, sometimes catching a masquerading and would-be runaway Commissioner whom he ought to have had the sense to let slip, at others elevating a very junior C. E. to Chief Engineer and having to pull him down again. It will soon be seen if he and his pets will cope with scarcity, for it is not going to be a famine with a tithe of the ability and success that followed the efforts of Sir R. Temple who left the supreme management of affairs to General (afterwards Sir Michael) Kennedy and his well disciplined Department. I don't say a word against Civil Engineers—but they have a more than usually difficult task before them with only a disorganised establishment wherewith to accomplish it.

BOMBAY P. W. D.

#### THE ACCOUNTS COMMISSION.

SIR.—It is hoped that large savings will be effected in two ways by this Commission (a) in the cost of the Calcutta Establishment, (b) in the number of returns and amount of clerical work required from Executive Engineer and their sub-divisional officers.

At present far from being a wholesome check on extravagance in any one division, the Accounts Branch indirectly aids in screening any and all useless expenditure—for an Executive Engineer relies more and more on the Calcutta office—and as long as that office considers his accounts and distribution of charges are correct, he himself is satisfied, and in many cases overlooks many faults made by his assistants and subordinates because they are not detected in Calcutta. The cost of the Calcutta Establishment might be reduced by increasing its scope. If a local Examiner and Paymaster is not required for large irrigation and provincial works, why is one necessary for a Railway? But is one necessary? If the Tirhoot State Railway requires an Examiner and a large local establishment, why is it not advisable to give similar advantages to the Nalhatta State Railway instead of working the two with one Examiner from Mozufferpore? If the two Railways can be worked satisfactorily from the one place, why not both still better from Calcutta—from Writer's Buildings—and with the present staff? Surely such amalgamation would effect some saving if centralization and the present system be adhered to.



Perhaps, however, decentralization (which appears to be the order of the day throughout India) with an Examiner attached to each circle might be better. Certainly this would effect a considerable reduction of clerical work in many ways even if the present returns are all retained. It is worthy of consideration.

So much for reducing the actual cost of establishment.

Cannot the number of returns and amount of work be reduced? A circular lately issued tends to reduce the number of day books in new irrigation projects; one day book now sufficing for all minor masonry works in any one Estimate, instead of separate day books for each work as heretofore. Cannot this be carried further? Why in some circles is it considered necessary to have a separate day book for each inspection or other bungalow under annual repairs? or why is it necessary to have five or more separate day books for any portion of a road under repair—a day book for maintenance, another for metalling, another for bungalows, &c.

Again, in the Provincial Branch in quadrennial or other repairs. Why when five or six civil buildings in one place and under one subordinate are being repaired, will not one day book for all buildings of this class suffice? By carefully preparing the original estimates and then strictly adhering to them, subsequent office work ought to be reduced to a minimum. There will be a stricter adherence by letting the responsibility rest directly on the Divisional officer and not indirectly on the Accounts Branch.

As to when and where the day books themselves should be prepared might also be considered. In the Provincial Branch they are as a rule originally drawn out by the Subordinates in charge of the work. In the Irrigation Branch, in most places by the sub-divisional officers. In the Railway Branch either in the Executive Engineer's office or at once in that of the Examiner. All being prepared from actual payments.

Again sub-divisional officers in the Railway and Irrigation Branches have clerks, but not so those in the Provincial—where an overseer is given a sub-divisional allowance for keeping the Imprest and preparing the Monthly Accounts. In one circle these clerks are cashiers, draw good pay and make payments in the absence of the sub-divisional officer—in another circle they are mere clerks. Why not do away with the sub-divisional allowance and allot a clerk or cashier to each sub-divisional officer?

The scope of the Commission might be extended so as to consider many subjects, but it should not omit to decide which is the best month for closing the official year in the P. W. D. Excepting for convenience in preparing the annual budget June is far preferable to March, as the working season of each year would then be continuous and not broken into two unequal halves, one of which is wholly lost for most works and the other too short for the remainder. With the year ending in June there would be fewer complaints of lapse of grants, slovenly work, and inconvenience to public officers while buildings are under repair.

WHITECHAPEL.

## IRRIGATION IN THE PUNJAB.

### V.

SIR,—The following further remarks are in continuation of those already published on the subject by you.

*Shapur Inundation Canal.*—As it is a Feeder Canal should be taken out from Chiniote tailing into and feeding the present new Chenab Canal, which could thus be made to tail into the Sidhnai Canal head at Serai Sidhnai near Mooltan, which district would then be almost entirely irrigated, as the Sidhnai should be carried down to Jelalpoor discharging its surplus water, if any remained, into one of the Lower Sutlej Canals about that point. The old bed of the Beas can be distinctly traced by the cultivation in the old channel between Geelawalla and Lodhran on the Indus Valley Railway, and if the people so gladly cultivate the ancient bed of the Beas, how much more so would they, if water for irrigation was to be had. The crops raised in the bed of this old river are almost the only signs of life between Soojabad and Lodhran, on the Indus Valley Railway.

It is believed to be feasible to construct a weir and canal head on the left bank of the Sutlej near Mailsie, in addition to that recommended at Hurreekkee. This, however, would mostly benefit the Bahawalpore, and would hardly be undertaken except at the expense of that State which, however, would probably eagerly contribute funds for this purpose as has been the case for the Sirhind Canal.

Finally, the mighty Indus, itself, should be attacked and its water utilized in benefitting and enriching the Province, instead of being a serious drag on Imperial resources as it has been, ever since the Annexation, in protective works for the two Cantonments of Dera Ismael Khan and Dera Gaze Khan. The protection of these Cantonments from destructive action of the Indus in flood, must have cost the Imperial Exchequer lakhs of rupees since 1849, whereas, had a series of Inundation Canals been excavated from both banks of the river, from Kalabagh to Rajanpore, a great deal of the expenditure on the Cantonments protective works, if not the whole amount, would have been saved. The Cantonments would probably never have been seriously threatened, and there would have been an immense increase in the Provincial revenues, while the benefit to the agricultural classes would have been simply enormous. Instead of these, we have after our nearly

forty years' administration of the Province, things almost precisely as they were in 1838, when the old Lion of the Punjab died. A canal should also be taken from the Koorma river, as the Toories are said to be anxious for a British Administration of their valley, and they are surely as well, or rather much better, entitled to consideration, than our turbulent subjects, the Swaties, if indeed they can be considered subjects at all. As the Koorma Valley is said to be a rich soil, it could, therefore, be made quite a garden if irrigation was available. Canals and Railways are the greatest of modern civilizers, and from a commonsense point of view, the former should have the preference on the principle first "catching your hare;" the application being first raise your crops and then provide the means of transport to the best market.

Ever since the conquest of Sindh by Sir Charles Napier in 1843, we have heard unceasingly that Kurrachee is the natural outlet and seaport for the Punjab and Northern India. A glance at any schoolboy's map will show this to be the case. The great waterway of the Punjab is the Indus, but in the way of utilizing its priceless resources for irrigation, scarcely anything worth the name has been done by the British Government during forty long years of enlightened administration.

It is sincerely to be hoped this state of things will not be permitted to continue, and that commencing with the present cold season, detailed surveys will be initiated for a series of canals from the Indus between the points indicated, and thus legitimate and profitable employment be found for the present unemployed, or at best, only half employed, Engineers, the Government at present hardly know what to do with.

The Shapore Canals conclusively establish, that Inundation Canals judiciously laid and constructed, would repay the original cost of construction in a very few years, probably ten at the very utmost, and as the Government of India can now obtain unlimited credit at 3 or the highest at 5 per cent., it is surely well worth while to commence canals in the Punjab in very earnest. One or two could easily be excavated in a period of five years at the utmost, and the distributaries made at the same time, and the canal opened in sections precisely as Railways are first opened, leaving say one chain of channels uncut at the tail end of every section, till the next was completed and so on to the extremity of the canal.

Of course the canals should, if possible, be provided with permanent masonry heads and weirs, but these should not be considered obligatory, and the canals constructed merely as "Inundation Canals" in the first instance.

In the same manner, expensive masonry bridges should be entirely omitted in the original construction, stout jungle timber village crossings being made where village roads cross, or where village lands would be severed by the canals. These are really all that would be necessary until the canals had repaid their original cost including interest and all miscellaneous charges incurred.

The foregoing suggestions are not made in anything of, or approaching, a carping spirit, but are made perfectly *bona fide*, and it is firmly believed in the best interests of all, and it is sincerely hoped they will be accepted and understood as such, and if they tend in any way to further the paramount object in view, the writer will be more than repaid for venturing to obtrude them on those whose province it is to initiate these works, and in proof of this, nothing better can be adduced than the concluding portion of Colonel F. J. Home's Report for the year 1886-87, which is as follows:—

"The Punjab presents an unrivalled field for irrigation projects; there is water, land of good quality, and sufficient surplus population to cultivate it, while the scanty and uncertain rainfall makes irrigation a necessity, and guarantees steady returns."

E. B.

## RE-ORGANIZATION OR DISORGANIZATION?

SIR,—Full use should be made of the valuable benefit which you have conferred upon the Public Works Department in publishing the Government scheme of re-organization in your issue of the 13th October.

Such radical changes as are therein suggested, cannot but be open to serious criticism; and though, of course, the Supreme Government has obtained, or will be furnished with, the matured views of Chief Engineers and Governors of Provinces, etc., and will be largely guided by them, there can scarcely be a doubt but that on an important matter of this kind the Viceroy and his advisers ought to be glad to welcome all and every means by which they may be enlightened as to how such a scheme would be received by the Department at large. If they do not actually invite public criticism, and the free expression of all opinions that can be formed upon the scheme, they will, one would hope, at all events read and weigh such as are voluntarily offered, before fully making up their minds to adopt irrevocably any experimental scheme of such vital interest to the whole Department as this bids fair to be.

A perusal of the papers above referred to is sufficient to shew that Government is seriously contemplating the adoption of proposals involving fundamental changes of a most serious nature in the constitution of the Public Works Department; changes too which are of such a kind as almost to preclude the possibility of their withdrawal should they prove to be a failure; while, even



were their withdrawal a possibility, the effects produced by the attempted innovations would assuredly be deep-seated and enduring.

I venture, therefore, to appeal through your columns, to all Engineers in the Department to read the proposals most carefully, to think over what they mean and what they entail, and after exchanging views as far as possible with their fellow Engineers, to give publicity to their conclusions in *INDIAN ENGINEERING*.

If, as I cannot but believe, it should transpire that there is a widespread feeling of alarm and dismay at the prospects placed before us by Government, the Viceroy and his councillors will surely pause and consider before they commit themselves to action in the direction indicated.

With your permission I will now submit a few of the ideas suggested to me by the perusal of the proposals.

The propounders of the scheme have apparently come to the following conclusions:—

(1.) That Engineers trained and engaged in India, have proved as a body to be either unfit to be entrusted with the "execution and repairs of works calling for high Engineering skill," or else undeserving of the status, pay, and emoluments which such duties evidently entitle Engineers educated and engaged in England to receive; or perhaps both unfit and undeserving—(vide paras. 2 and 3 of quotation from the Report of the Public Service Commission).

*Corollary.* This conclusion must have been derived from actual observation of the behaviour of, and work hitherto done by, Roorkee and other Indian Engineers. Is the conclusion justified by any general facts or statistics, and if so, should not the grounds for attaching such a stigma to the Indian Engineers be, in justice to them, published?

(2.) That if the Provincial Service is organized as an evidently *second class* service, compared with the Imperial, the Government will nevertheless obtain (perhaps we must not presume to say *continue* to obtain) from one or more "well equipped Indian Colleges," (vide para. 7.) Engineers with a "high education" (though of course not *too too* high) who will be quite prepared to expend the result of their "high education" solely on the "construction and maintenance in the several provinces of works not ordinarily calling for high Engineering skill" (vide para. 5 of report as quoted). That such men, moreover, bearing the title and rank of Executive or Assistant Engineer will contentedly, as a matter of course, play second fiddle, both professionally and socially, as they undoubtedly will tend to do, to their comrades from England—or that if they don't—"it doesn't matter."

*Corollary.*—Government must have some good grounds, perhaps some precedent, for such a conclusion; perhaps the system of a second class superior Engineering service, side by side with a first class superior service, exists in some other country, and has been found to answer and to work harmoniously. The Government might kindly enlighten us on this point.

(3.) That the happy men now in the Department, below the grade at which "we are to draw the line of separation" (vide point 4 of the enclosure) who may presently find themselves classed as Provincial, and will be thereby branded as either unfit to control and direct "the execution and repair of works calling for high Engineering skill," or no longer deserving of the rank and emoluments of the Imperial service (even though they may be allowed as a favor to enjoy them in the form of a personal allowance), that these men will go on working away just as happily, contentedly and loyally as if nothing had happened, and won't mind practically being debarred from all chance of becoming Superintending or Chief Engineers, or the prospect of being looked down upon by the Royal Engineers, the Cooper's Hill men and their own friends and neighbours; and that if they do mind, and don't remain contented—"it doesn't matter."

(4.) That the rank of Assistant Engineer, and of Executive Engineer, will continue to carry, *per se*, as it does at present, an undoubted title to social and official equality with Anglo-Indians of the upper classes; that there will hereafter be no differentiating in society between *pucca* and *kutchia* Executive Engineers, such as will be distasteful both to the gentlemen who at present bear the title, and their wives, and to the Government whose first grade Executive Engineers take precedence officially with Lieutenant-Colonels, Private Secretaries, and other officers of the same stamp; or that if there is—"it doesn't matter."

(5.) That there will be no friction, between *kutchia* Executives and *pucca* Assistants, *pucca* Superintending Engineers and *kutchia* Executives enjoying an "increment," born of disappointed hopes and declared (though not admitted) inferiority on the part of the *kutchia* Executive; and that if there is—"it doesn't matter."

(6.) That (vide para. 29) though "the men in the upper grades would look upon it as a very great grievance and slur upon them to be placed in a class which must inevitably be looked upon as the inferior class," the men in the lower grades who are to be shunted will not do so; and if they do—"it doesn't matter." For are they not all, with very few exceptions, if any, Natives, Eurasians, or Europeans whose domicile is in India (vide close of para. 29), and have consequently got no feelings to be considered, or sense of justice; while, on the other hand, with regard to the upper grades we are told (in the same paragraph) that "some of them, though not a very large number, are men whose domicile is in England." It is difficult to reconcile this mode of argument

with a genuine profession of respect for, and justice to, all British subjects, whatever their origin.

The above are some of the conclusions to which the advisers of Government appear to have come, judging by the detail with which they have already begun to work out the scheme; for although (vide para. 22 of their scheme) they revert to the alternative idea, suggested by the Government of India, in para. 12 of its letter, as an *equally important question*, they only allude to it, I think, once; and their cursory treatment of it evidently indicates that it is not *their* idea of a sound or desirable solution of the difficulty. I have purposely endeavoured to frame the above remarks in an incisive style, with a view of foreshadowing in a harmless way, and if possible preventing, the bitter feelings which will assuredly be engendered by the pursuit of such an ill-conceived policy as is implied in the suggested disruption of the existing Superior Engineering service into Imperial and Provincial.

I would fain assist Government to realize that if it persists in carrying out such an arbitrary, unscientific, and impolitic scheme, it must be at the sacrifice of what little patience and contentedness still remains in the Department. Surely Government cannot be ignorant that the majority of the Civil Engineers in its service are, as it is already, whether rightly or wrongly, burning under a combined sense of injustice, promises unredeemed, prospects shattered, wrongs not righted, grievances ignored; the English trained Civil Engineers feel that they are not fairly treated as compared with the Royal Engineers; the bulk of the men engaged in India, seeing their comrades granted concessions and themselves excluded, have an additional bitter grievance. Will the Government of India not pause before it proceeds to degrade them, and with them the whole profession, still further?

Surely this is a case in which the Institute of Civil Engineers might, for the honour of the profession at large, step forward and protest against the proposal to lower the dignity of a rank to which so many of their honoured members belong.

And this too, when, on the face of it, the alternative scheme suggested in para. 12 of the Government of India's letter, would appear to be so admirably suited to the end in view.

If the Government will only make up its mind to declare that, having found by experience (as we must conclude they have) that English trained Engineers, on the whole, pay the best for the purposes of control, direction, and the execution of important works, they intend in future to recruit the Superior establishment from England only; that Indians and others who aspire to this service must seek to enter it through English schools and colleges, where they can alone obtain a suitable moral and scientific training, and that colleges in India are only in future to train for the Subordinate service; if Government will slightly improve the pay and prospects of the higher Subordinate service (*i.e.*, overseers and upwards) so that intelligent men can, on entering it, hope to attain, by a faithful and fairly long service, to a comfortable and honourable position, there will be no need for an intermediate and unnatural service. A plentiful supply of experienced, practical, and sufficiently educated men will undoubtedly be obtained, capable of filling all the posts for which the qualification of an educated gentleman are not required with contented servants. Such men not having entered the service with the ambition of being called Assistant and Executive Engineers, will not expect to occupy the higher positions, and consequently will not resent the same being held by their admitted superiors in station; while the latter will not feel injured by being linked with a pronounced inferior class of men claiming equal rank and position.

A few Europeans born and bred in India, who by parentage and social position are qualified to seek admittance to the Superior service, but who are debarred by lack of means from obtaining an English training, will no doubt miss the present facility for entering the Superior service.

Such men would, *à fortiori*, resent the admission to a *second rate*, *shabby*, *genteel* service such as the Provincial service must degenerate into, and must suffer in either case. It must be remembered, however, that the Government is in no way bound to seek to make arrangements for this or that comparatively small class of British subjects, whether English or Indian, to whom it has not pledged itself. Its sole object in organizing its services must be to obtain efficient servants as cheaply as possible, consistently with fairness to *all* classes, justice to those with whom it has already entered into relations, and, let us hope, a desire and determination to see its servants contented and happy.

In conclusion, I hope that all Civil Engineers, whatever views they may have hitherto entertained of the Civil Engineers' Association, will in the face of the great danger to all classes of the profession now looming in the near future in the shape of this untoward scheme which has been propounded by Government, see the desirability of supporting the movement, and of strengthening the hands of the Committee by every legitimate means in their power.

We look to the Committee to strive hard, among other things, to dissuade the Government from committing itself to such a suicidal and baneful scheme, which must prove, in the sequel, disastrous no less to the Government, than to its unfortunate, but notwithstanding their hardships, loyal servants.

I may add, that I am *not* one of the Engineers educated or engaged in India.

POUNDS.

October 30, 1888.



General Articles.

GOCULDASS TEJPAL HOSPITAL (NATIVE).

TOWARDS the cost of constructing this building the late Mr. Goculdass Tejpal gave 1½ lakhs of rupees, the actual cost of construction being Rs. 3,67,465. It is erected on the northern part of the Esplanade, facing south-east. The building designed by Colonel Fuller, R.E., is officially said to be in the early English Gothic style, but has incurred the stricture of representing a curious mixture of styles, and of shewing a disproportionate quality of roof. It has accommodation for 88 male and 44 female patients; it has three floors, is 250 feet in extreme length and 83 in extreme breadth, including the porch. A stone staircase in the entrance-hall leads to each floor. There are corridors on all sides, 8 feet wide in the clear. The main feature is, the centre of the building is lighted in front and rear by large windows pierced with Gothic tracery. The general facing is of blue basalt, coursed; the arches are of Coorla stone, the rooms and corridors are paved with Minton's tiles, and the roofing with Taylor's patent tiles. The columns are of Coorla stone, with caps and cornices of Porebunder stone. The building contains 685,146 cubic feet.

The history of the construction of the Goculdass Tejpal Hospital is interesting. Mr. Rustomjee Jamsetjee Jeejeebhoy, in 1865, offered to provide £15,000 towards defraying the expense of another native hospital, if Government would give £10,000 and the site, and if the Municipality would support the hospital, and this was agreed to. But the great financial crisis intervening, Mr. Rustomjee could no longer give effect to his original beneficent intention, and the whole scheme collapsed for a time and was only rehabilitated through the efforts of Mr. Arthur Crawford, who waited on the late Mr. Goculdass Tejpal with the plans and obtained from him a cheque for £15,000. By means of this splendid donation Mr. Crawford succeeded in inducing Government and the Municipality to abide by the former arrangements.

It will thus be seen that had it not been for Mr. Crawford, Bombay would never have had the advantage of this useful Institution, and bearing in mind all he has done for Bombay we confess to a sentiment of deep sympathy with him in his present unfortunate situation.

The work was commenced on the 10th May 1870 and finished on the 8th April 1874.

XENOPHON.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

XXXVIII.

Ordinary Iron-work in Roofing—straps, bolts clips, &c.

Items per lb. (1.)	No. or Quantity. (2.)	Rate. (3.)	Amount. (4.)	Total. (5.)
<i>Labor.</i> —				
Blacksmith	No. ...	·05	Variable	Do.
Hammerman	" ..	·05		
Bellows boy	" ...	·05		
<i>Materials.</i> —				
Iron including waste lb.	1½	Variable	Do.	Do.
Charcoal lb. ...	■			
<i>Sundries</i> —				
Petty Establishment ...	...			

BANGALORE WATER-SUPPLY.

AN ESSAY CONTRIBUTED BY A. H. GARRETT,  
*Executive Engineer, P. W. D., Madras.*

1. *Scope of Present Paper.*—Bangalore is situated on one of the highest points of the Mysore Plateau, and on the crest of the watershed which separates the valleys of the Arkavutty and Penaukeny, the two nearest rivers. In respect of distance from, and elevation above, the only rivers of any magnitude, the town is most unfavorably placed, and the question of an economical water-supply is one of great difficulty. The scope of the present paper is limited to the consideration of a "scheme for the supply of pure drinking water for the troops in Bangalore." (G. O. No. 2810 W. of 20th October 1887). The troops to be supplied only number about three thousand, and the quantity of water they require is so small, that it becomes possible to make use of sources which might be considered unsuitable if the supply of a large population was in question.

2. *Available Sources of Supply.*—The various sources of supply may be divided into Rivers, Wells and Reservoirs.

(1.) *Rivers.*—Three rivers have been mentioned as available sources of supply. Of these, the Caveri is eighty miles from Bangalore, the Arkavutty twelve miles, and the Penaukeny fifteen miles, whilst their bed levels at the nearest points are respectively 220 feet, 200 feet and 700 feet below Bangalore.

The levels of these rivers are unfavorable as well as their distances from Bangalore, and there are only two reasons which could make it advisable to go to any one of them as a source of supply. These reasons are:—(a) Impossibility of obtaining a sufficient quantity of water nearer Bangalore. (b) Impossibility of obtaining nearer Bangalore water suitable for drinking purposes. With regard to (a) it might hold good if we were dealing with the supply of the whole population of Bangalore, but the amount of drinking water required by the troops is only 9,000 gallons per diem and it is quite certain this quantity can be obtained without going twelve miles from Bangalore.

In respect of the (b) quality of the water obtainable near Bangalore, it has to be observed that there are no grounds for concluding that better could be supplied by any one of the three rivers mentioned above. On the contrary, the chances would be in favor of getting the best water near Bangalore, where it would be possible to obtain sufficient water from a small gathering ground, which would admit of precautions being taken against its pollution.

(2.) *Wells.*—Wells offer many advantages for the supply of the small amount of water required, and would probably furnish the best and cheapest source if a water bearing stratum of considerable extent could be found containing good water. The experience, however, gained from existing wells in Bangalore, shews that it is impossible to foretell whether a well sunk in any particular locality will yield good water or bad. The character of water taken from wells in the same compound is often totally different. Moreover, it frequently happens that a well after yielding excellent water for years, will, from causes which it is impossible to determine, suddenly furnish a supply quite unfit for drinking. This uncertainty regarding the character of the water inseparable from any scheme depending upon wells, is a fatal objection to their employment.

(3.) *Reservoirs.*—The only other source which remains to be considered is that afforded by reservoirs, and the first point to be decided is whether any of the existing tanks round Bangalore could be utilized as a source of supply.

This question has already been pretty well threshed out, and it seems clear that none of the existing tanks would answer.

They are under the disadvantage of having gathering grounds subject to pollution, and water taken from



INDIAN ENGINEERING.



"PHOTO-TINT" by James Akerman & Co. Queen Square London W.C.







them might also interfere with the rights of owners of land under the tanks. It follows, therefore, that the only way to supply the troops with good drinking water is by the formation of a new reservoir, since it has been shewn that no possible advantage could be obtained by resorting to either the Caveri, the Arkavutty or the Penaukeny, and that wells could not safely be depended on for a continual yield of good water.

3. *Site of Proposed Reservoir.*—There is no site near Bangalore where a reservoir could be formed, from which an adequate supply could be obtained by gravitation. Pumping must be a feature in any scheme of this kind, and the only thing to be done is to select a site which offers facilities for the construction of a reservoir certain to receive an ample supply of good water, which can be delivered in Bangalore at a moderate cost.

Such a site is to be found near the village of Sagipaliya on the road to Magadi, about six miles from Bangalore. At this place the road crosses by a bridge of 45 feet span a stream which runs between two high hills.

The valley is very narrow and the site offers most exceptional advantages for the construction of a reservoir.

The soil is laterite, and in many places the underlying live rock comes out on the surface. No decayed rock was noticed anywhere. The reservoir embankment would probably be not more than 250 yards in length, and it could be carried down to the live rock for a comparatively trifling cost. The arrangements for the disposal of surplus rainfall would be simple and inexpensive.

4. *Catchment Area.*—The drainage area above the proposed embankment is a little over 4 square miles. The country is very hilly, for the most part uncultivated, and favorably circumstanced as regards the absence of all causes likely to affect the purity of the water falling on its surface.

5. *Amount of Water available for Storage.*—The average of two years of lowest consecutive rainfall is 28 inches. It has been shewn by Colonel Mullins that the Ooperhalli reservoir only received  $\frac{1}{3}$ th of the total rainfall, and, accepting this proportion, we may count on an available rainfall of 3.5 inches. The area of the reservoir for calculating loss by evaporation may be taken at 20 acres. We then have:—

209,088,000 gallons available rainfall.

41,381,990 " evaporation.

167,706,010 " remainder.

55,902,003 " unavoidable waste at  $\frac{1}{3}$ rd.

111,804,007 " total available for storage. The amount required being only 3,285,000 gallons.

6. *Remarks on Calculations.*—One-eighth of the rainfall has been taken as available for storage. This is the proportion received by the Ooperhalli reservoir, the catchment basin of which is not nearly so hilly as that of the Sagipaliya reservoir. Evaporation from the surface of the reservoir has been allowed for at the rate of  $\frac{1}{4}$  inch a day. The situation of the reservoir will not be an exposed one, and at Ulsoor tank, evaporation amounts to 0.20 inches a day. Unavoidable wastage has not been allowed for by Colonel Mullins. It has been entered at  $\frac{1}{3}$ rd, which is the proportion adopted by Colonel Tulloch in his calculations for the water-supply of Bombay.

7. *Character and Cost of Scheme now brought forward.*—The general arrangements of the scheme, now under consideration, would be as follows. There would be 3 settling beds in the reservoir, each containing about two weeks' supply. From these, water would be conveyed to the filters, and thence to a clear water cistern capable of holding one week's supply.

From the cistern, water would be pumped into an iron tank placed on the top of the hill near the reservoir. This tank to hold 30,000 gallons.

From the tank, water would be supplied to the barracks by gravitation, and would be drawn off from stand posts.

The works necessary for the supply of 9,000 gallons daily and their approximate cost are as follows:—

	Rs.
Reservoir ... ..	20,000
Settling beds ... ..	5,000
Filters ... ..	5,000
Clear Water Cistern ... ..	5,000
Engines and Engine House ... ..	10,000
10 Miles of 2 $\frac{1}{2}$ " Iron Pipes at Rs. 4,000 a mile ... ..	40,000
Iron Tank ... ..	10,000
Stand Cocks ... ..	5,000
Compensation ... ..	10,000

Total ... 1,10,000

The total annual cost would be:—

Working Expenses ... ..	2,000
Interest and Depreciation ... ..	11,000

Total ... 13,000

8. *Remarks on above Estimate.*—The cost of the reservoir will probably be considered too low. The bund, however, would be a very short one. Also it would not be high, as it would not be necessary for the reservoir to hold all the water available for storage, amounting to over 300 thousand gallons a day, where only 9,000 gallons are required.

*Settling Beds.*—Ample provision has been made for these. Captain Romilly estimated the settling beds in "Project A" to cost Rs. 16,290—the daily supply being 60,000 gallons.

*Filters.*—The amount allowed is probably excessive. In the note on Water-Supply of Bangalore forwarded by the Government of India, the cost of two filters, each capable of passing 9,000 gallons a day, is estimated at Rs. 2,000.

*Clear Water Cistern.*—Ample provision has been made. At Rs. 5 per 100 gallons allowed in the Government of India Note, the cost would only be Rs. 3,150.

*Engines and Engine House.*—Water will have to be pumped up about 200 feet into the iron tank. Two engines are allowed for—Messrs. Richardson and Cruddas' quotation for each engine delivered at Bombay is Rs. 1,050. Each engine would be capable of pumping water to the required height, at the rate of 1,500 gallons per hour. More than enough has been allowed for the Engine House.

*Pipe Track.*—The reservoir is less than 6 miles from Bangalore, and the total length of the pipe track is not likely to exceed 10 miles. The cost at Rs. 4,000 a mile is what is given in the Government of India Note on the Bangalore Water-Supply.

*Iron Tank.*—Cost based on estimate received from Richardson and Cruddas.

*Stand Cocks.*—These would cost less than the sum allowed.

*Compensation.*—The Amildar of Bangalore was written to in order to ascertain the amount which would be required for compensation. An abstract of his estimate is given below:—

	Rs.
Houses ... ..	4,000
Building Sites ... ..	2,500
Trees ... ..	14,000
Wells ... ..	3,000
Sand ... ..	58,610
Total ... ..	82,110

He estimates the total area of the catchment to be 3,088 acres or nearly 5 square miles. Of this amount 5 acres are garden land, 5 acres are under wet cultivation, 2,273 acres grow dry crops, and the remainder is waste.

To purchase the entire catchment would cost Rs. 82,110.

It would, of course, be a great advantage to have complete control over the gathering ground above the proposed reservoir, but by the expenditure of Rs. 10,000 all the present sources of pollution could be got rid of.

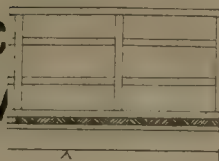






# UDINAL SECTION

C  
OV



26'-6"

20'-0"

82'-6"

H. W. L.

Groz

A

B

C

all cr

L. W. L.

## NOTE

- D No. 3 32'x10'x12"
- B No. 3 42'x10'x12"
- Y No. 3 50'x10'x12"

## CROSS SECTION

Scale 4' 1 inch.



10'x12"

13'-0"

4'-0"

19'-0"

14'-0"

22'-0"

6'-0"

25'-0"







Thus  $T V G = \beta$ . In the spherical triangle  $V T G$  we have  $T = 90^\circ$ . Thus

$$\begin{aligned}\tan T G &= \tan T V G \sin T V \\ &= \tan \beta \sin \phi \\ \text{The arc } Z G &= Z T - T G \\ &= 90^\circ - \theta - T G \\ \sin Z F &= \sin F G Z \sin Z G \\ &= \sin F G Z \cos (\theta + T G)\end{aligned}$$

and  $\cos T V G = \cos T G \sin F G Z$  by spherical Trigonometry, because  $T = 90^\circ$

$$\begin{aligned}\therefore \sin F Z &= \frac{\cos \beta}{\cos T G} \cos (\theta + T G) \\ &= \cos \beta \cos \theta - \cos \beta \sin \theta \tan T G \\ &= \cos \beta \cos \theta - \sin \beta \sin \theta \sin \phi \quad (3)\end{aligned}$$

by introducing the value given above for  $\tan T G$ .

This equation includes as a particular case our equation (1) which was

$$\sin Z R = \cos \theta \cos \beta$$

For until we introduce the relation which connects  $\beta$  with  $\theta$  and  $\phi$ , we may consider  $\phi$  as a third arbitrary angle and may in (3) put  $\phi = 0$ . In the figure the circle  $V H$  is drawn normal to  $S Q U$ . Then in the right angled triangle  $V H U$  we have by spherical Trigonometry

$$\cos V U = \cot V U H \cot U V H$$

$$\therefore \cot U V H = \frac{\sin \phi}{\cot \theta}$$

Because  $V U H$  or  $T U S$  is  $\theta$

and  $U V T = \beta$  as above explained

$$\begin{aligned}\therefore \cot H V P &= \cot (U V H - \beta) \\ &= \cot U V H \cot \beta + 1 \\ &= \frac{\cot \beta - \cot U V H}{\cot \beta - \cot U V H} \\ &= \frac{\sin \phi}{\cot \theta} \cot \beta + 1 \\ &= \cot \beta - \frac{\sin \phi}{\cot \theta}\end{aligned}$$

$$= \frac{\sin \phi \cot \beta + \cot \theta}{\cot \beta \cot \theta - \sin \phi}$$

$$\text{Also, } \sin H V = \sin V U \sin V U H$$

$$= \cos \phi \sin \theta$$

because the arc  $T V = \phi$

$$\text{also } \tan H P = \sin H V \tan H V P$$

in the right angled triangle  $P H V$

$$\text{Thus } \tan H P = \frac{\cos \phi \sin \theta (\cot \beta \cot \theta - \sin \phi)}{\sin \phi \cot \beta + \cot \theta}$$

$$\text{and } \tan U H = \tan U V \cos H U V$$

$$= \cot \phi \cos \theta$$

$$\therefore \tan (U H - P H)$$

$$\begin{aligned}&= \frac{\cot \phi \cos \theta - \frac{\cos \phi \sin \theta (\cot \beta \cot \theta - \sin \phi)}{\sin \phi \cot \beta + \cot \theta}}{\sin \phi \cot \beta + \cot \theta} \\ &= \frac{1 + \cot \phi \cos \theta \cdot \cos \phi \sin \theta (\cot \beta \cot \theta - \sin \phi)}{\sin \phi \cot \beta + \cot \theta}\end{aligned}$$

$$= \frac{\cos \phi \cos \theta \cot \beta + \sin \phi \cot \beta + \cot \theta}{\sin \phi \cot \beta + \cot \theta}$$

$$= \frac{\cot \phi \cos^2 \theta - \cos \theta \cos \phi \cot \beta + \cos \phi \sin \phi \sin \theta}{\sin \theta}$$

$$= \frac{\cos^2 \theta \cos^2 \phi \cot \beta - \cos^2 \phi \sin \theta \cos \theta}{\sin \phi}$$

$$\begin{aligned}&= \frac{\cot \phi}{\sin \theta} \left\{ \cos^2 \theta + \right. \\ &\quad \left. \cot \theta \left\{ 1 - \cos^2 \phi \sin^2 \theta \right\} + \right. \\ &\quad \left. \sin^2 \phi \sin^2 \theta \right\} \\ &= \frac{\cot \beta}{\sin \phi} \left\{ \sin^2 \phi + \cos^2 \theta \cos^2 \phi \right\}\end{aligned}$$

$$\text{Thus } \tan U P = \frac{\cos \phi (\cos^2 \theta + \sin^2 \phi \sin^2 \theta)}{\cos \theta \sin \phi (1 - \cos^2 \phi \sin^2 \theta) + \sin \theta \cot \beta (\sin^2 \phi + \cos^2 \theta \cos^2 \phi)}$$

If in this equation we put  $\phi = 0$  (4) we shall obtain a result equivalent to equation (2). Accordingly we obtain

$$\begin{aligned}\tan U P &= \frac{\cos^2 \theta}{\sin \theta \cot \beta \cos^2 \theta} \\ &= \frac{\tan \beta}{\sin \theta} \\ &= \tan U Q \text{ by (2)}\end{aligned}$$

This testing of equations (3) and (4) by reducing them to (1) and (2) respectively is useful as a partial guard against accidental errors in the calculations. Again, (4) asserts that if  $\beta = 0$ , the point  $P$  coincides with  $U$  for any value of  $\phi$ . This should be the case for the  $\phi$ -rotation will then operate on the  $T U$  plane and, therefore, have no effect on the plane as a plane. Had equation (4) not reduced to equation (2) when  $\phi = 0$ , we should have inferred the existence of some accidental algebraical error in the manipulation of the value of  $\tan U P$ .

The equation (4) admits of simplification

$$\text{For } 1 - \cos^2 \phi \sin^2 \theta =$$

$$\begin{aligned}&\cos^2 \phi + \sin^2 \phi - \cos^2 \phi (1 - \cos^2 \theta) \\ &= \sin^2 \phi + \cos^2 \theta \cos^2 \phi\end{aligned}$$

Now in this Trigonometrical identity change  $\phi$  to  $90^\circ - \theta$  and  $\theta$  to  $90^\circ - \phi$ . This we may do because  $\phi$  is still an arbitrary angle.

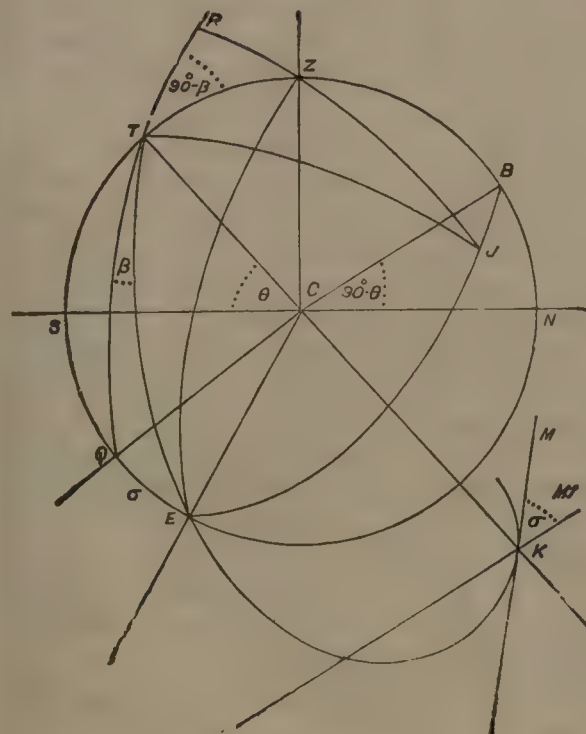
$$\text{Thus } 1 - \sin^2 \theta \cos^2 \phi = \cos^2 \theta + \sin^2 \theta \sin^2 \phi$$

Hence (4) reduces to

$$\tan U P = \frac{\cos \phi}{\cos \theta \sin \phi + \sin \theta \cot \beta}$$

$$\text{or } \cot U P = \cos \theta \tan \phi + \sin \theta \cot \beta \sec \phi \quad (4)$$

Fig. 5.



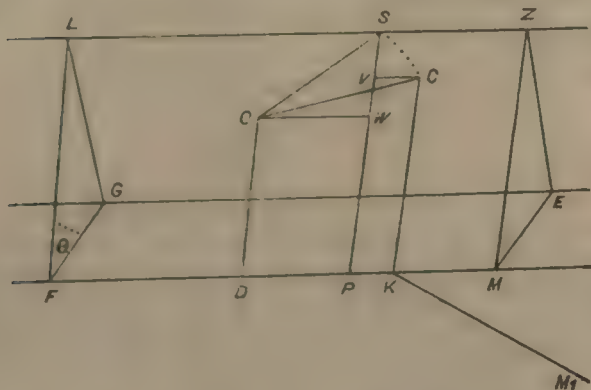
We may now introduce the conditions for  $\phi$ . The  $\beta$ -rotation of fig. 5 causes the wheel to bury itself in the ground to a distance  $r \sin \omega - r \sin \theta$  where  $\omega$  is the angle which  $T Q$  makes with the horizon, and  $r$  the front wheel radius. The  $\phi$ -rotation causes an additional burying  $= r \sin \lambda - r \sin \omega$  where  $\lambda$  is the inclination of  $P V F$  to the horizon. Therefore, the vertical displacement which we call upon the translation movement to undo is

$$\begin{aligned}&r \sin \lambda - r \sin \theta \\ &= r \cos Z F - r \cos Z T\end{aligned}$$

where  $Z F$  is given by equation (8).



Fig. 6.



If we refer to fig. 6, which is here reproduced, we see that the  $\phi$ -rotation lifts the front wheel centre, from C to S.

Let  $OC = c$

= distance between wheel centres.

Let  $CO$  make an angle  $\alpha$  with the line  $DK$ . Then  $c$  and  $\delta$  are constants of the machine, i.e., they are independent of  $\beta$  or  $\theta$ .

In fig. (6) we draw  $CV$  parallel to  $KD$ . Then  $SV$  is the displacement of  $C$  measured up the plane, therefore the vertical lift of  $C$

$$= SV \sin \theta$$

$$= (SW - VW) \sin \theta$$

$$= c \sin \theta \{ \sin \alpha + \phi - \sin \alpha \}$$

Our equation for  $\phi$  is, therefore,

$$c (\sin \lambda - \sin \theta) = c \sin \theta \{ \sin \alpha + \phi - \sin \alpha \} \quad (5)$$

where  $\lambda$  is a function of  $\phi$  by (3) and in fig. 6  $SO C = \phi$ .

Now if we introduce our dynamics, we see that we shall not have a considerable  $\beta$ -rotation performed by itself and followed by a correspondingly considerable  $\phi$ -rotation which would be performed with the  $\beta$  results in *statu quo*. We shall really have a small  $\beta$  movement followed quickly by a small  $\phi$  movement. Or we may treat these movements as simultaneous. They would be absolutely simultaneous if the ground was absolutely inelastic and impervious, and if the parts of the machine were incompressible and entirely without "play."  $\beta$  is a disorganizing movement and  $\phi$  is a movement of recovery or restitution. As a matter of mere mathematics we know that small displacements may be taken in any order and, therefore, we may take them as consecutive or simultaneous. We will now consider what our five equations give us when  $\theta$  is decidedly different from  $90^\circ$ , and when  $\beta$  is such a small angle that we may recognise  $\beta$  the circular measure of the angle, but neglect  $\beta^2$  and other higher powers of  $\beta$ . When  $\beta$  is small  $\phi$  will of course be small. We anticipate this result without examining the equations. When two quantities are each small, their difference must be small. But we must not conclude that they are equal, either exactly or approximately, simply because their difference is small. To any one who has properly reflected on the subject the difference between '001 and '002 is as intense as the difference between 1,000 and 2,000. When two quantities are small, their ratio becomes the one important question. Thus we are really asking, what will be the value of  $\phi$  when  $\beta$  becomes small and  $\phi$  is correspondingly small.

By Trigonometry we have

$$\sin \beta = \beta - \frac{\beta^3}{6} + \&c.$$

$$\cos \beta = 1 - \frac{\beta^2}{2} + \&c.$$

By equation (1)

$$\cos \omega = \cos \theta \cos \beta$$

$$= \cos \theta \left( 1 - \frac{\beta^2}{2} + \dots \right)$$

Or  $\omega = \theta$

to the first order of small quantities because we are to neglect  $\beta^2$  &c.

$$\tan \beta = \beta + \frac{\beta^3}{3} + \&c.$$

By equation (2)

$$\tan \sigma = \frac{\tan \beta}{\sin \theta}$$

Therefore, approximately

$$\sigma = \frac{\beta}{\sin \theta}$$

We cannot draw any inference from this equation because the changed track is not  $QC$  but  $PC$ .

By equation (3)

$$\cos \lambda = \sin FZ$$

$$= \cos \theta \cos \beta - \sin \theta \sin \beta \sin \phi$$

$$\sin^2 \lambda = 1 - (\cos \theta \cos \beta - \sin \theta \sin \beta \sin \phi)^2$$

As  $\phi$  will be small, we write

$$\sin \phi = \phi - \frac{\phi^3}{6} + \dots$$

$$= \phi$$

to our order of small quantities assuming provisionally that  $\phi$  is at least as small as  $\beta$  when  $\beta$  is small

$$\therefore \sin^2 \lambda = 1 - (\cos \theta - \beta \phi \sin \theta)^2$$

If we neglect  $\beta^2$  we should equally neglect  $\beta \phi$ , provided  $\phi$  is either equal to  $\beta$  or less than  $\beta$ . Assuming then that  $\phi$  is not greater than  $\beta$  and reserving this matter for future inquiry, we must write

$$\sin^2 \lambda = 1 - \cos^2 \theta$$

$$\therefore \lambda = \theta$$

to our present order of approximation.

The equation  $\lambda = \theta$  does not imply the identity of the planes  $TU$  and  $VP$ . It only implies that the wheel so turns as not to increase or diminish its slope to such an extent as to be appreciable, if we agree to ignore  $\beta^2$ .

By equation (4), as we simplified it, we have

$$\begin{aligned} \tan P U &= \frac{\cos \phi}{\cos \theta \sin \phi + \sin \theta \cot \beta} \\ &= \frac{\cos \phi \tan \beta}{\sin \theta + \cos \theta \sin \phi \tan \beta} \\ &= \frac{\cos \phi \tan \beta}{\sin \theta} \end{aligned}$$

neglecting  $\sin \phi \tan \beta$

$$\text{Thus } \tan P U = \frac{\tan \beta}{\sin \theta} \text{ approximately}$$

neglecting  $\phi^2$  and therefore putting  $\cos \phi = 1$

Thus, if we neglect  $\beta^2$  and assume that  $\phi$  is not greater than  $\beta$  we have appreciably

$$\begin{aligned} \tan P U &= \frac{\tan \beta}{\sin \theta} \\ &= \tan \sigma. \end{aligned}$$

As a matter of fact, we shall find presently that  $\phi$  is considerably less than  $\beta$  when  $\beta$  itself is small. Without using any approximation we may note that

$$\begin{aligned} \tan P U &= \frac{\cos \phi}{\cos \theta \sin \phi + \sin \theta \cot \beta} \\ &< \frac{1}{\cos \theta \sin \phi + \sin \theta \cot \beta} \\ &< \frac{1}{\sin \theta \cot \beta} \end{aligned}$$

or  $UP < UQ$  as the figure (7) implies.

Returning to our present approximation, we have

$$\tan P U = \frac{\tan \beta}{\sin \theta}$$

We may now inform professional bicyclists of a fact with which some of them are probably unacquainted, and, as experience shews, some of them will be disposed to doubt. This fact is that a bicycle handle is increased in sensitiveness by the bicycle being on a slope, i.e., not upright.

If we could have  $\theta$  as small as  $30^\circ$ , the handle sensitiveness—or the front wheel sensitiveness to its handle—would be about doubled.



When a bicycle runs upright, a  $\beta$ -rotation changes the front wheel momentary track by the quantity  $\beta$ , and no  $\phi$ -rotation being needed none comes into play. When a bicycle running is at a slope  $\theta$ , a small  $\beta$ -rotation changes the track, not by  $\beta$ , but by  $\frac{\beta}{\sin \theta}$ . The ratio of the larger deflection to the smaller is as  $\text{Cosec } \theta$  to 1.

If  $\theta$  were or could be  $30^\circ$ , one deflection as just now stated would be exactly double the other for equal infinitesimal values of  $\beta$ .

In equation (5) we have

$$r(\sin \lambda - \sin \theta) = c \sin \theta \{ \sin \overline{a + \phi} - \sin a \}$$

This reduces to  $\phi = 0$ .

The meaning of this result is that when  $\beta$  is small  $\phi$  is much smaller. We were therefore justified in neglecting the quantity  $\beta \phi$  or the quantity  $\phi^2$  after we had decided to neglect  $\beta^2$ .

It was the  $\phi$ -rotation which changed Q U to P U and if  $\phi$  is zero P U remains equal to  $\sigma$ , as we found in the algebraical work. We shall in the next paper proceed to make a closer inquiry into the value of  $\phi$ . We shall keep  $\beta^3$  in our expressions and neglect  $\beta^3$ ,  $\beta^4$ , &c. We shall then find that P U differs slightly from Q U. But our statement just made to professional bicyclists and probably now for the first time published or discovered, remains unaffected and true qualitatively. The statement is that the handle sensibility increases as  $\theta$  decreases.

#### ERRATA.

In paper 6 page 353. The figures 5 and 7 have their numbers interchanged.

In paper 5 page 332 paragraph 6 for the words "as one rigid body" substitute "without rotation."

In the (true) figure 7 the point I is printed L.

#### NOTES FROM HOME.

(From our own Correspondent.)

THE *Builder* of last week will be of interest to your readers. It contains well executed illustrations of the Great Indian Peninsula Railway Terminal Buildings in Bombay. These drawings consist of the south-west carriage porch the central feature of the Buildings; the west elevation; the principal dome and a view of the entrance under the principal carriage porch, besides a general plan of the whole. The description of the Building and the materials employed were given by the same Journal in its issue of 23rd October 1886.\*

The last issue of the *Graphic* contains in a supplement an illustrated account of the History of the Railways of England, a specially interesting feature of which is the series of sketches of steam road carriages. As affording a striking contrast to the uncouth carriages of the Liverpool and Manchester Company of 1837 the supplement concludes with an artistic sketch of the interior of the Great Western Railway Company's Royal Saloon, a perfect specimen of taste and comfort. The supplement is in short a thoroughly interesting one, not only for Railway men, but for all classes of the public.

Whilst the Metropolitan Railway has extended its system to Harrow Richmansworth and in other directions, the District Company are making an important extension of their line from Putney to Wimbledon, thus practically invading the South-Western Railway territory. By this connection passengers on the South-Western system will undoubtedly be much benefited, for instead of being compelled as at present to take cab or omnibus on their arrival at Waterloo will have access through the Metropolitan circle to all parts of the city.

This line has involved the construction of a bridge over the Thames at Putney and in the construction of this bridge the latest improvements have been adopted. Thus instead of the heavy timber work between the cross girders on which the road way was in past days generally carried, the bridge is floored with undulating iron plates, which besides supplying a good surface for the roadway helps to knit the whole structure together. The bridge consists of eight spans, five

of which are across the river of 153 feet each and three of 100 feet. Work on about three-quarters of the bridge is now practically completed and the remaining portion will it is expected be finished by the end of the year or early in 1889, when the whole line will be ready for traffic. The line which is only about 5 miles in length has involved some heavy and interesting work which is being carried on in Messrs. Lucas and Aird's well known substantial manner.

I have received a prospectus of the Junior Engineering Society, whose opening meeting of the session was held on the 12th instant, when Professor Unwin delivered an address on Illustrations of the use of Theory in the work of the Engineer. Papers on various subjects of technical interest are appointed to be read at these seven meetings of the session. Well-known names appear on the list of Council and the objects of the Society are such as to insure its being undoubtedly a boon to the junior members of the profession from whom I understand it is receiving a very rapidly extending support.

The Institution of Mechanical Engineers notify that their next meeting is to be held on the 25th instant, when the discussion on Mr. Towne's paper on the Description of Emery's Testing Machine and the Honourable C. Parsons paper on a Description of the Compound Steam Turbine and Turbo Electric Generator will be continued. Papers are also to be read on a Description of the Rathmines and Rathgar Township Waterworks and a supplemental paper on the use of Petroleum Refuse as Fuel in Locomotive Engines.

The preliminary survey in connection with the scheme for the construction of a canal from Sheffield to Goole is practically completed and the report of the Engineers may be shortly expected. The chief promoters of the scheme with their Engineer have been lately visiting the various canal systems of the country and of the Midlands especially, carefully inspecting the shipping accommodation and the various appliances for the prompt shipment of coal. There seems to be a general agreement as to the practicability of the project and it appears also that a substantial amount is in hand to cover preliminary expenses.

An arbitration is now being held in Chester over a dispute between the Manchester Ship Canal and the Shropshire Union Companies concerning the price of a piece of land of 45 acres running from Ellesmere Port to Pool Hall Rock, Eastham. It was purchased by the latter Company in 1870 for £12,000 and it is contended that one of its elements of value was its frontage to the River Mersey. The Ship Canal Company made an offer of between £6,000 and £7,000 as compensation, but this sum was refused. Judging from the formidable array of Counsel and of witnesses whose services are called in, there seems to be cause to think that some simpler course might have been adverted to for the benefit of both sides of the dispute.

One of the evidences of the revival of trade in this country, which it is always pleasant to note, is the fact that for the quarter ending 30th September last, there were 400 steam and sailing vessels of 698,995 tons under construction in the United Kingdom at the close of the quarter as compared with 249 of 394,340 gross tonnage at the close of the corresponding quarter of the previous year.

## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

Punjab, November 1, 1888.

Mr. F. W. K. Yeoman, Assistant Engineer, 2nd grade, Umballa Provincial Division, passed, on the 1st October 1888, the Lower Standard Examination in Hindustani.

Mr. E. E. Oliver, Under-Secretary to Government, Punjab, Public Works Department, is appointed to officiate as Superintendent of Works from the 31st October 1888 and posted to the 2nd Circle, *vice* Mr. J. W. Wright, proceeded on privilege leave.

Mr. T. E. Ivens, Executive Engineer, 1st grade, is appointed to officiate as Superintendent of Works and posted to the 3rd Circle of Superintendence with effect from the afternoon of the 31st October 1888, *vice* Lieutenant-Colonel E. Harvey, R.E., on deputation.

Mr. J. E. Hilton, Executive Engineer, of the Lahore Provincial Division, is appointed to officiate as Under-Secretary to Government, Punjab, Public Works Department, with effect from the forenoon of 29th October 1888, *vice* Mr. E. E. Oliver.

Mr. T. E. Ivens, Executive Engineer, 1st grade, on being relieved of the charge of the 3rd Circle of Superintendence by

\* Our Correspondent evidently forgets that like illustrations and descriptive matter have already appeared in this Journal.—ED., J. E.



Lieutenant Colonel E. Harvey, R.E., was attached to the office of Secretary to Government, Punjab, Public Works Department, from the 15th to the 31st October 1888, both dates inclusive.

#### *Irrigation Branch.*

Colonel E. C. Garstin, Executive Engineer, 1st grade, returned from the one month's privilege leave, granted in Irrigation Branch Memorandum dated 11th August 1888, on the forenoon of the 2nd October 1888, and took over charge of the Patiala Division and the Canal Agency Office, Sirhind Canal, from Mr. E. S. Bellasis, Executive Engineer, on the forenoon of the same date.

With reference to Irrigation Branch Memorandum, dated 1st October 1888, Mr. E. A. Sibold, Executive Engineer, 1st grade, returned from one month's privilege leave on the forenoon of the 6th October 1888, and took over executive charge of the Lower Sutlej and Chenab Division, Inundation Canals, from Mr. P. S. McGowan, Executive Engineer, on the forenoon of the same date.

Mr. F. W. Carne, Assistant Engineer, 2nd grade, attached to the Ludhiana Division, Sirhind Canal, passed the Colloquial Examination in Hindustani, on the 5th October 1888.

With reference to Irrigation Branch Memorandum, dated 7th July 1888, and Notification, dated 23rd July 1888, Mr. J. Benton, Executive Engineer, 2nd grade, returned from three months' privilege leave on the afternoon of the 3rd October 1888, and took over executive charge of the Ludhiana Division, Sirhind Canal, from Mr. S. Preston, Executive Engineer, on the afternoon of the 5th idem.

Mr. E. S. Bellasis, Executive Engineer, 3rd grade, from the Patiala Division, Sirhind Canal which he left on the afternoon of the 2nd October 1888, to the 1st Division, Bari Doab Canal, which he joined on the afternoon of the 7th idem.

With reference to Irrigation Branch Notification, dated 6th October 1888, Major J. F. J. Miller, Executive Engineer, 1st grade, returned from one month's privilege leave on the afternoon of the 9th October 1888, and took over executive charge of the 1st Division, Bari Doab Canal, from Mr. J. J. Mullaly, Executive Engineer, on the forenoon of the 10th idem.

#### **November 8, 1888.**

His Honor the Lieutenant-Governor is pleased to sanction the following temporary promotions and reversion, in the amalgamated Engineer Establishment of the General and Irrigation Branches of the Public Works Department, Punjab, with effect from the dates specified against the officer's name:—

Mr. J. G. Davis, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Mr. Day, proceeded on furlough, with effect from 7th May 1888.

Mr. J. G. Davis, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, on Mr. Bayley's return from furlough, with effect from 23rd May 1888.

Mr. J. G. Davis, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Mr. Fraser, proceeded on furlough, with effect from 16th June 1888.

Mr. J. G. Davis, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, on Mr. Ivens' return from furlough, with effect from 10th August 1888.

#### *Irrigation Branch.*

With reference to Irrigation Branch Notification, dated 6th August 1888, Mr. H. W. V. Colebrook, Executive Engineer, 2nd grade, returned from three months' privilege leave on the forenoon of the 16th October 1888, and took over executive charge of the Ferozepore Division, Sirhind Canal, from Mr. H. V. S. Baker, Executive Engineer, on the forenoon of the same date.

With reference to Punjab Government Irrigation Branch Notification, dated 30th May 1887, Mr. T. J. P. Jeffery, Executive Engineer, 1st grade, landed at Bombay on return from the 15 months' furlough, therein granted, on the 24th September 1888, and is posted to the Chenab Canal Division, which he joined on the afternoon of the 29th September 1888. Mr. Jeffery took over executive charge of the Chenab Canal Division from Mr. J. J. Hatten, Executive Engineer, on the afternoon of the 3rd October 1888.

Mr. J. J. Hatten, Executive Engineer, 3rd grade, from the Chenab Canal Division, which he left on the afternoon of the 3rd October 1888, to the Western Jumna Canal Circle, which he joined on the afternoon of the 6th October 1888. Mr. Hatten has been posted to the office of Superintendent of Works, Western Jumna Canal, on special duty.

Mr. R. A. Molloy, Executive Engineer, 2nd grade, took over executive charge of the Dera Ghazi Khan Division, Indus Canals, from Mr. R. D. Bayley, Executive Engineer, on the afternoon of the 11th October 1888.

Mr. R. D. Bayley, Executive Engineer, 1st grade, from the Dera Ghazi Khan Division, Indus Canals, to the office of Superintending Engineer, Derajat Circle, of which he took over charge from Mr. H. Garbett, Superintending Engineer, on the afternoon of the 11th October 1888, on the occasion of the latter officer proceeding on 23 days' privilege leave granted in Irrigation Branch Memo, dated 15th October 1888.

Mr. J. J. Mullaly, Executive Engineer, 2nd grade, from the 1st Division, Bari Doab Canal, which he left on the forenoon of the 11th October 1888, to the 2nd Division, Bari Doab Canal, which he joined on the afternoon of the same day.

#### **Burma, November 3, 1888.**

Mr. H. F. White, M.I.C.E., Superintending Engineer, 1st Circle, is granted privilege leave from the 27th instant to the 22nd November 1888, both days inclusive. This cancels Public Works Department Notification, dated the 5th September 1888.

With reference to Notification dated the 27th October 1888, granting 26 days' privilege leave to Mr. H. F. White, M.I.C.E., Superintending Engineer, 1st Circle, it is hereby notified that the work of the Superintending Engineer, 1st Circle, will be undertaken by the Chief Engineer during the absence of the Superintending Engineer on leave.

With reference to *Gazette of India*, Public Works Department, Notification, dated the 20th September 1888, Lieutenant J. E. Capper, R.E., Assistant Engineer, 1st grade, reported his arrival at Rangoon on the forenoon of the 29th October 1888. Lieutenant Capper is posted to the 3rd Circle of superintendence for employment as Personal Assistant to the Superintending Engineer.

Mr. P. E. Raven, Assistant Engineer, 1st grade, Rangoon Division, availed himself of the language leave granted him in *Burma Gazette* Notification, dated the 29th August 1888, on the forenoon of the 2nd October 1888.

#### *Burma State Railway.*

Mr. G. F. Berrill, Sub-Engineer, 1st grade, and Honorary Assistant Engineer, is placed in charge of the 4th division, Toungoo-Mandalay Extension, Burma State Railway, during the absence on privilege leave of Mr. W. Wiseman, Executive Engineer, or until further orders.

#### **Madras, November 6, 1888.**

The following posting is ordered:—

Colonel W. G. Burton, R.E., Superintending Engineer, 3rd class, sub. *pro tem.*, to the charge of the 5th Circle.

#### **Bombay, November 8, 1888.**

The Governor in Council is pleased to make the following appointments:—

Mr. W. S. Howard, M. Inst. C. E., Chief Engineer, 1st class, temporary rank, to act as Chief Engineer, Southern Division.

Lieutenant-Colonel J. D. Cruickshank, R.E., on being relieved by Mr. Howard, to be Executive Engineer, Belgaum and Kolhapur.

Mr. E. Finhey, on being relieved by Colonel Cruickshank, to be Executive Engineer, Ratnagiri and Kolaba.

Mr. W. C. Hughes, M. Inst. C. E., to act as Secretary to Government, Public Works Department.

#### **N.-W. Provinces and Oudh, November 10, 1888.**

##### *Irrigation Branch.*

His Honor the Lieutenant-Governor, North-Western Provinces, and Chief Commissioner, Oudh, is pleased to order the following reversion and promotion, with effect from the dates specified:—

Mr. H. J. Strickland, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, consequent on the return of Mr. Nicolls from furlough, with effect from 20th October 1888.

Mr. J. R. C. Nicolls, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Mr. Strickland, reverted, with effect from 20th October 1888.

With reference to Notification, dated 27th October 1888, transferring him to the 3rd Circle, Mr. H. M. J. Bacon, Assistant Engineer, 1st grade, is posted to the Betwa Canal.

#### **India, November 10, 1888.**

Mr. J. E. Dallas, Executive Engineer, 3rd grade, sub. *pro tem.*, State Railways, is attached to the Office of the Secretary to the Government of India, Public Works Department.

Lieutenant-Colonel E. Harvey, R.E., Executive Engineer, 1st grade, Punjab, is appointed to officiate as a Superintending Engineer, during the absence of Mr. J. W. Wright, on privilege leave, or until further orders.

Mr. E. E. Oliver, Executive Engineer, 1st grade, Punjab, is appointed to officiate as a Superintending Engineer, during the absence of Lieutenant-Colonel Harvey, R.E., on special duty, or until further orders.

Rai Preonath Ghose Sahib, Executive Engineer, 4th grade, temporary rank, North-Western Provinces and Oudh, temporarily employed on State Railways, is permanently transferred to State Railways and will remain posted to the North-Western Railway.

The services of Lieutenant-Colonel C. E. Shepherd, Executive Engineer, 1st grade, State Railways, are, on return from furlough, placed at the disposal of the Bombay Government for employment on Railway Surveys.

#### **Bengal, November 14, 1888.**

Notification, dated 6th November 1888, regarding the posting of Mr. Mackinnon to the Tirhoot State Railway, is cancelled.



## ADVERTISEMENTS.

D. P. W. India.

## IMPORTANT NOTICE.

All Civil Engineers of the Department are informed, that, owing to the extended support accorded to the Civil Engineers' Association, the Committee feel it necessary to still further widen their sphere of influence, and to delegate some of their duties.

The current work has been entrusted to Local Sub-committees, who will correspond with the Central Committee.

Every Civil Engineer is urged to write to the Hon. Sec. c/o Grindlay, Groom and Co., Bombay, who will put him in touch with his Sub-committee, with the view of enrolling him a member of the **Civil Engineers' Association.**

## P. W. D., BENGAL.

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Akra Brick Factory Division

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Tenders for the supply of one 20 H.-P. Stationary Engine horizontal, and one 15" Centrifugal Pump, will be received in this office up to 12 noon on the 17th proximo, when they will be opened by the President.

2. Each tender must be addressed to the President, and be accompanied by a deposit of Rs. 100 in Currency Notes, and be sealed and superscribed "Tenders for supplying 20 H.-P. Stationary Engine and 15" Centrifugal Pump."

3. Every tender not accompanied by such deposit will be rejected.

4. No tender will on any account be received after the hour fixed for opening the tenders.

5. The President does not bind himself to accept the lowest, or any tender, and may reject any tender, without assigning any reason for so doing.

6. The successful tenderer will be required within 15 days, from the date on which the acceptance of the tender shall have been notified to him, to deposit in this office, in cash, or Government paper, 10 per cent. of the value tendered for, as security for the fulfilment of his contract.

7. The deposit of all other tenderers will be returned, as soon after the final disposal of all tenders as practicable.

8. Should the successful tenderer fail to furnish such security for the due fulfilment of his contract as aforesaid, within the time specified for that purpose, he shall forfeit his deposit of Rs. 100 to the Municipality, and the tender will in such case, be considered as having been rejected, or abandoned, and the President will thereupon at such time or times in such manner and on such terms, as he may think fit, arrange for the supply of the required plant, by any other person or persons, and the defaulter shall be held liable, irrespective of such forfeiture aforesaid, for all damages, loss, costs, charges and expenses arising from, or by reason of such failure, and arrangements.

9. A specification of the plant to be supplied, and the terms and conditions on which it is to be supplied can be obtained at this office.

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Acting Vice-President.

MADRAS ;

9th November 1888. }



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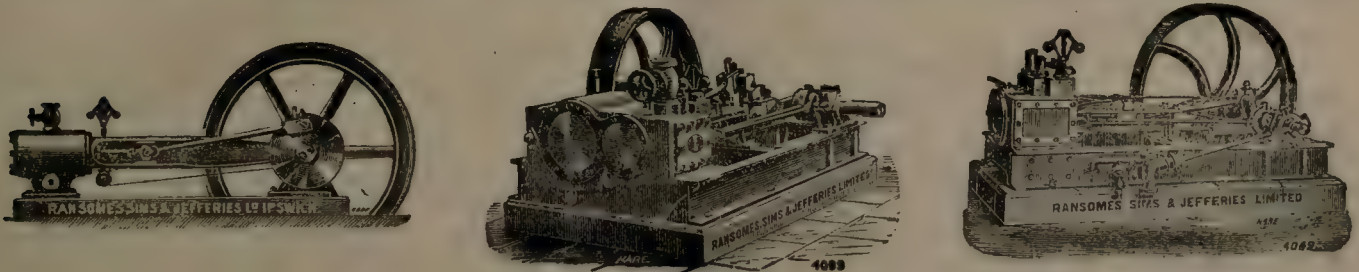
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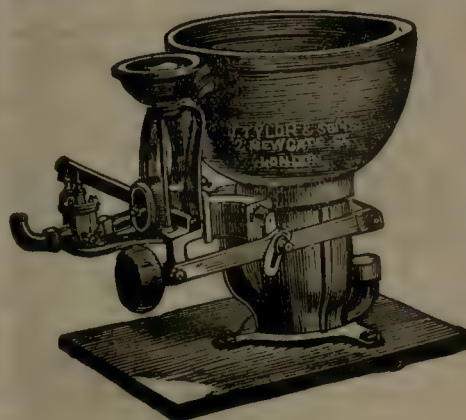
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General correspondence, and all communications bearing upon literary matters, should, as heretofore, be addressed to PAT. DOYLE, C.E., Spence's Hotel, Calcutta.

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As the issues of the journal containing the articles headed as above are out of print, and sufficient inducement having offered, the matter has been reproduced in pamphlet form to meet the requirements of District Officers and others in Bengal and elsewhere.

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# INDIAN ENGINEERING.

SATURDAY, NOVEMBER 24, 1888.

### RECENT GIRDER DESIGNS FOR INDIA.

It is not clear why the 250' through spans of bridges on the same line should be so different as are those of the Ken and Kalpi bridges on the I. M. Railway, described in our issue of 25th August, as designed by Mr. G. Berkley and Sir S. M. Rendel, respectively, and illustrated on 27th October and 1st September.

Being designed by two different engineers accounts of course for certain differences, but one would have supposed that a girder good enough for one bridge would have done for the other, as there does not appear to be anything special in either, so far as erection is concerned.

In considering the differences, we may include with the Kalpi girders those for the Chenab Bridge on the Sind-Sagar Railway, near Multan, illustrated in *The Engineer* of 14th September. Both have much the same proportion of depth, and agree in general design, in which we are happy to see the absurd custom of stiffening the main braces has been abandoned, and a raking end post, a better brace, has been introduced for the first time in the India Office practice, so far as we can remember, in girders over 150' span.

The main points of difference in the designs are these:—

	KEN BRIDGE	KALPI BRIDGE.
1 <i>Form.</i> —	Semi-parabolic.	Rectangular.
2 <i>Ratio of depth to span.</i> —	$\frac{1}{8}$	$\frac{1}{6}$
3 <i>Panel length.</i> —	21'4"	12'6"
4 <i>Top chords.</i> —Material in sides, latticing only on top, no diaphragms.		Box with diaphragms in middle of bays.
5. <i>Bottom chords.</i> —Side plates only.		Trough.
6. <i>Attachments.</i> —Braces in the plane of the gusset connected by covers on both sides.		Braces run to side of gussets and are riveted direct.

On the first point there is not much to be said, inasmuch as the practical consideration of cost of workmanship is a factor as well as the theoretical minimum obtainable by the parabolic girder. There is probably not much difference; at all events, the Americans, who are an eminently practical people, have decided the question in favor of parallel chords, even in much larger spans. On the second, and consequently the third point, there can scarcely be a difference of opinion, and as this point is a radical difference, and not one of mere detail, we have remarked on it at greater length below.

On the fourth point, although the design of the Ken Bridge carries out the principle of uniform stress by a symmetrical distribution of material, no exception can be taken to the top chord of the Kalpi Bridge, provided the top plate be kept quite thin throughout. The intermediate diaphragms make an excellent job in a compression member.

On the fifth point we should prefer the arrangement in the Ken Bridge, since there cannot be a more favor-



able distribution of material in a tension member than the vertical plates symmetrical on both sides. The bottom plate is useless, as the diagonal floor bracing should secure the necessary lateral rigidity, and in the event of the compression from wind strains on the empty bridge being greater on any panels of the windward chord, than the tension from the dead load, a small angle bar would give sufficient stiffness. We may remark incidentally that the parabolic form has this advantage, as it throws more strain on the chords, it is less likely that any bay of the lower chord will be found to require counter-bracing.

Regarding the sixth and last point of difference, we incline on the whole to the practice of the Kalpi bridge. It is true that theoretically the ties should be in the plane of the pieces against which they pull, and should be covered on both sides, but against this there is the not inconsiderable practical disadvantage of a lot of small pieces and double the quantity of rivetting, whereas with the ties at the side of the gussets and rivetted direct to them, it is only necessary to allow for a few extra rivets in each joint, on account of the loss of strength caused by the increased bonding moment on the rivets.

To revert to the question of shallow girders and small panels; we remarked there could scarcely be a difference of opinion. Some Engineers apparently think these proportions desirable, for they continue to design them, but so long as bridgework is paid for by the ton to a given design and backed up by the purse of the Government of India or a large Company, there is no incentive to economy, the proportions that may have been good enough for plate girders of small span being applied without discrimination to trusses of large span.

We are convinced that if the American system of tenders for the bridge as a whole; leaving the dimensions of the truss to the manufacturer whose interest it then is to employ as his Consulting Engineer the best bridge designer he can find; were followed the shallow truss with small panels would, by the survival of the fittest, speedily become extinct. The depth of the Ken bridge—32'—is the least consistent with reasonable economy, and in America a 250' girder would have been nearer 40' than 30' deep, while the Kalpi Bridge is under 27'.

There is one consolation. The defects of the English bridges are on the safe side, while the badly designed American bridges, as the frequent failures prove, are most dangerous. But it must not be supposed for an instant that these failures represent the work of the first-class bridge shops in which safety is by no means sacrificed to economy; and though the precise dimensions of the girders are left to the manufacturer, the strength of every part is subject to a rigid scrutiny by the Company's Engineer, to whom the strain sheets have to be submitted with the tender.

**Railway Girders of the World.** Recently published statistics show that of the total Railway mileage of the world 74 per cent. is of the standard 4ft. 8½ in. gauge, 14 per cent. is narrower, and 12 per cent. is wider than the standard. In America, apart from the comparatively small mileage of the United States lines with 3ft. gauge, practically the whole of the United States and Canadian Railways are of 4ft. 8½ in. to 4ft. 9 in. gauge. In Mexico, in 1884, 2,083 miles were 4ft. 8½ in. and 241 ft. gauge.

## THE GOVERNMENT RESOLUTION OF APRIL 1, 1876.

WHEN in 1876 the question of Furlough and Leave allowances to the U. C. Service was raised by the Government of India in their Financial letter, dated 29th January 1875, lists were sent home to the Secretary of State of such officers as the Government of India deemed should have the more favorable leave rules, and instructions were asked as to what classes of uncovenanted servants should benefit by improved leave and pension rules.

In sanctioning the extension to the 244 members of the P. W. D., named by the Government of India, of the more favorable rules, the Secretary of State replied in his letter, Financial No. 48, dated 10th February 1876 (published in the Government of India Gazette, of the 1st April 1876):—

1. I have considered in Council your Financial letter 29th January 1876, on the subject of the leave rules of the U. C. S.

2. You therein state that you have some doubts as to the intentions of the Duke of Argyll, and as to the manner in which effect should be given to His Grace's instructions. \* \* \* \*

11. In respect to the future, I request that it may be clearly understood, that the less favorable leave rules will be applicable to all uncovenanted servants appointed after the year 1871, unless—

(1.) They have been appointed in England.

(2.) They have been appointed in India with the sanction of the Secretary of State. \* \* \* \*

12. It will be.....expedient to apply a different mode of treatment to the present incumbents of those offices which will in future, so.....certainly be filled up as a rule from England, and those which may possibly continue to be filled in India. The Uncovenanted Service of the P. W. D.—except in so far as it is recruited from students educated at the Indian Civil Engineering Colleges, which were specially designed for the natives of the country—will ordinarily in the future be supplied from Cooper's Hill.....The limited opportunity which exists in India for obtaining men of scientific training furnishes an obvious reason for confining, as a general rule, to persons selected in England the higher grades of the Telegraph and Geological Survey Departments.....

This despatch struck the first note of warning to all men of education and ambition, that those who preferred the easier Indian gate of admission to the Scientific Departments to the harder and narrower English Entrance (to borrow a simile of Sir J. Gorst) could not expect the same treatment as those who passed the severe English competitive tests.

The injustice lay in legislating back, in its para. 11, written in 1876, for men appointed after 1st January 1871. Those men appointed to the P. W. D. from Indian Colleges prior to 1st April 1876, the date of publication of this despatch, had no hint that their treatment would



differ in any way from that of other officers performing the same duties. Those who entered after this order was made public, stand on quite a different footing.

### A MODEL STATE.

It has always struck us as a notable fact in the administration of Native States, that while the responsible advisers of the Feudatory Princes are thorough masters of accounts and the balancing of receipts and expenditure, the financiers under the Government of India are quite at sea when a deficit is to be met or a saving to be effected.

Our readers will remember that ten years ago there was a severe famine in the Madras Presidency. It told heavily in loss of life everywhere, especially in Mysore. Those unacquainted with the resources of the Province, expected a serious collapse, but such was not to be the case. Notwithstanding the heavy loss, the craft of State righted itself and to this day is going smoothly along with much advantage to the governors and the governed.

It should here be premised that there is a representative assembly in Mysore, composed not only of those who represent the wealth of the land, but its intelligence as well.

At the Durbar held there in Dusserah last, the yearly Budget was laid before them. Let us see what a picture of advancement and prosperity we are confronted with here.

Looking back to the history of the Province, the Dewan stated that in 1886-87 the revenue realised was 127½ lakhs, the highest in the financial history of the Province. It was a rise of thirteen and a quarter lakhs over the previous year, 1885-86, and now it is fully two and a half lakhs more than in 1886-87. It should, however, be understood that there has been an increase in the expenditure under almost every item.

Coming to details, and especially to those which concern the Engineering profession, we find that liberal grants in excess of those of last year have been made under several heads. The principal of them are as follows:— In 1887-88 a sum of sixteen and a half lakhs was fixed for the Public Works Department, but owing to large irrigation works and important bridges being taken in hand this year, it had to be fixed at twenty lakhs. Under "Railway" the sum of Rs. 2,19,000 has been allotted, as the extension to Harihar is fast approaching completion, and provision has to be made for payment of interest on the capital outlay. Under Forest, owing to extensions of plantations and to increased felling operations to meet the greater demand for timber of all kinds and for sandalwood, a sum of Rs. 75,000 has been set apart.

In regard to the State Railway and its extension, it has been executed under a contract concluded by the Secretary of State for India, acting on behalf of the Maharajah. It is to be in force for 46 years, that is, from

30th June 1886 to the 30th June 1932, the amount raised by the Company for the purpose amounts in Indian Currency to Rs. 1,63,82,801. Of this sum Rs. 68,60,508 is to be devoted towards payment to the Mysore State of the actual capital outlay on the Mysore-Gubbi line after 30th June 1886, and Rs. 95,22,293 (or such portion of it as may be absolutely necessary) towards expenditure upon the construction and equipment by the Company of the extension from Gubbi to Harihar. The sum of Rs. 68,60,508 which has been paid to the Maharajah, has been utilized by him towards the partial liquidation of the famine debt due to the Government of India. Since then two payments of four lakhs each have been made towards that debt, and by next December the entire claim of the British Government will have been cleared off, by the payment of Rs. 1,94,404. The extension from Gubbi to Harihar is being proceeded with as fast as the circumstances of the case will permit, but it is on no account to exceed 80 lakhs, the total cost, therefore, of the line from Mysore to Harihar will be Rs. 1,48,60,000.

In regard to irrigation a great deal has been done. It has been decided to spend 9½ lakhs solely on irrigation; of this sum 8½ lakhs are to be devoted to purely original works, that is, to new tanks and channels, or to the improvement, enlargement, or extension of those already existing so as to increase their irrigating power. As to the marked progress made in this direction, we have only to compare the grant given for this year with the amount expended in 1882-83. In the last six years it has more than doubled; and if the labor difficulty can be safely tided over, the State proposes to spend over 9½ lakhs, and this, it should be remembered, without the waste of a single rupee in unnecessary outlay. Taking an unit of water as the requirement for the irrigation of an acre of land, when all the tanks are completed, there will be an addition of over 33,000 acres to the already existing tank irrigated area of the Province.

Taking the channels and making a fair allowance for their extensions budgetted for, but which have not been worked out in full detail, we find that 29,733 additional acres will be brought under irrigation during the next five years.

With regard to the fuel supply, a problem which must sooner or later engage the serious attention of the Durbar, it has been deemed necessary to extend several State forests, and fresh jungle tracts have been brought under proper conservancy. But while the State is looking to its own resources, it is not unmindful of the claims of the ryots, and certain concessions have been made to them in the matter of grazing in reserved forests at certain seasons and in certain parts on payment of a trifling fee. In connection with the subject there are two questions before the State: one is the free grant of wood for certain public purposes, and to ryots for making cattle sheds, and in talooks exempted from forest laws, also for building purposes; the second relates to the grant of land on favorable terms for private plantations. When these two points are settled, there will be very little left in the way of perfecting Forest arrangements.



## Notes and Comments.

**THE NEW GOVERNOR OF LADAK.**—Mr. A. Atkinson, formerly of the Public Works Department, finishes constructing the road to Murree before taking up his appointment as Governor of Ladak.

**A USEFUL HINT.**—In consideration of sunshine and the prevailing wind during the greater part of the year, no public clock, the works of which are near its dial, should be otherwise exposed than facing the north.

**RAILWAY EXTENSION.**—Sanction has been given to the construction by the B. B. & C. I. Railway Company of a broad gauge branch from Annand to Petlad, and it is understood that the work will be commenced at once.

**A RICH FIND.**—Dr. Noetling, having examined the so-called "Magnetic rock" of Singaung, in the Shan Hills of Burmah, has discovered that the hill where the rock was said to be found is a huge mass of valuable iron ore.

**BENGAL COAL.**—We learn that the B. I. S. N. Company have contracted for 300,000 tons of country coal for next year, and as the actual consumption of the Company is barely half that figure, this investment bespeaks a large export—to Singapore, we believe.

**FAMINE PROSPECTS IN BENGAL.**—Prices have generally fallen in Orissa consequent on the welcome rainfall, but it is thought expedient to continue the relief works wherever distress lingers. The outlook in Behar is very dark, and it is believed that nothing can avert the calamity of famine.

**MADRAS MEAN TIME.**—We glean from the Madras Government Astronomer's Report that this is transmitted daily at 4 P.M. to all Government Telegraph Offices in India, as practised since February 1873, with sufficient accuracy for all requirements of the Postal, Telegraph, and Railway services.

**MR. T. H. WICKES.**—The many friends of Mr. Wickes will be glad, in a personal sense, to learn that he returns to Bengal shortly: although we feel sure that they would unite with us in wishing that he could have continued to act in the important post of Chief Engineer and Secretary to a Local Government.

**BENGAL P. W. SECRETARIAT.**—We learn that the Joint Secretary (Irrigation) and Under-Secretary (Buildings and Roads) accompanied His Honor to Orissa: and the Secretary, Mr. Martin, has just gone to Tirhoot. These moves seem to indicate that the necessity for famine relief measures has not entirely been avoided.

**S. M. R. OFFICES, DHARWAR.**—The Southern Maharatta Railway office buildings at Dharwar are being pushed on rapidly. The offices are described as massive yet elegant, and apart from the convenience of having them all together, the Company will not, after their completion, have, as now, to pay highly for rent of private buildings.

**EAST COAST RAILWAY.**—Government having decided on the survey of the line of Railway proposed by Mr. Turner from Bezwada to Cuttack, a number of nominations have been made for the purpose, including something like a dozen Executive Engineers, four of whom are First Grade. A Chief of the staff has not been selected as yet.

**BURMA STATE RAILWAY.**—We believe the Director-General of Railways has brought to the notice of the Government of India the high cost of Revenue Establishment of the Burma State Railway as compared with

other Indian lines. Perhaps if this Railway were handed over to a private company it would be worked on more commercial principles than under Government.

**THE BARODA STATE RAILWAY SYSTEM.**—We hear that the B. B. & C. I. Railway Company yesterday started the construction of an extension of His Highness the Gaekwar's two-foot-six Railway system from Bahadup to Budeli, a distance of about 13½ miles. The earthworks, which will give employment to a large number of laborers, will be completed before next monsoon.

**A COMMERCIAL UNDERTAKING.**—The new brewery of the Murree Company now in course of erection at Rawalpindi is a big concern, the proposed outlay being estimated at 8 lakhs of rupees. The buildings are on the European model and will be large enough, and fitted in every way, for the production of 2,000 hogsheads of beer weekly. Mr. J. S. Attfield and Sirdar Sajan Singh are the contractors.

**BENGAL-NAGPUR RAILWAY.**—The opening of the Bengal-Nagpur Railway as far as Raepore was to have taken place about the 19th instant. The Consulting Engineer to Government went over the line a few days since and expressed his approval of the work done. The Grand Opening of the line has been deferred until the section as far as Belaspur is complete, and this is expected to be in about two months.

**A RAILWAY EVENT.**—The linking in of the section of the Indian Midland Railway between Bhopal and Jhansi took place at Lalatpur last week amidst great rejoicings. A through train, with the Engineers and other officials, performed the entire journey, one hundred and eighty miles, without a hitch. Ere long, it is expected, there will be through communication without a break between Bombay and Jhansi, *via* Etarsi and Bhopal.

**SUPERINTENDING ENGINEERSHIPS.**—That gradually vanishing quantity, the Superintending Engineer, it is whispered to us, is doomed. The reduction of Provincial Divisions is of course the root of it, and we shall expect to hear very shortly of one Superintending Engineer in Bengal for Provincial Works. In Irrigation, a change of designation to Inspectors of Irrigation and in Railways to Engineers-in-Chief, &c., will probably take place.

**MADRAS MARINE BUDGET, 1889-90.**—A very considerable expenditure on work which will benefit the various ports concerned, is contemplated, including among them a screw-pile boat jetty at Tellicherry (Rs. 1,46,915); improvements to the entrance of the Kallai river (Rs. 2,000); a pillar and light at Point Calimere (Rs. 15,000); light-towers and quarters on two headlands in Canara district (Rs. 10,000); and a stone jetty at Kundapur (Rs. 3,000).

**MR. G. A. D. ANLEY.**—This Superintending Engineer, 1st grade, Bengal, has retired from the service. His retirement dates from the 16th instant and offers a vacancy in the higher grades, for which no doubt many will run a close race. Mr. Anley has served about 28 years in the Public Works Department and has worked in several capacities including that of Under-Secretary. He was laborious and earnest in all he did, but was known to be very slow to recognize merit.

**LIEUTENANT-COLONEL A. C. BIGG-WITHER.**—We learn that this officer, who was deputed to Beluchistan a few years back and who acted there as Secretary in the P. W. D., to the Agents to the Governor-General and holds the temporary rank of Superintending Engineer, 3rd grade,



will in all probability return to Bengal shortly owing to the completion of the special works which have been in progress. Being a senior officer his return will bring about several changes and reversions.

**GOVERNMENT BRICK AND TILE FACTORY, MADRAS.**—We learn from the D. P. W. Administration Report for 1887-88 that a sum of Rs. 500 was sanctioned for making experiments for producing decorative porcelain. The experiments made were on the whole successful. A specimen panel was exhibited at the Fine Art Exhibition held at Madras and was much admired. A quantity of this material is being prepared for the exterior of the new Presidency Magistrate's Court now under construction.

**ANNUAL CONFIDENTIAL REPORTS ON OFFICERS OF ROYAL ENGINEERS SERVING IN INDIA.**—The Commander-in-Chief in India having brought to the notice of the Government of India the desirability of extending to all officers of Royal Engineers serving in India the system of annual confidential reports applicable to other officers of the British service, the Governor-General in Council is pleased to direct that arrangements in regard to the submission of such reports will come into effect forthwith.

**MR. J. H. TOOGOOD.**—We cannot help expressing regret that an officer like Mr. Toogood, who had done very good service in the Bengal Irrigation Branch, and was specially successful as Superintendent of the Seebpore Workshops, should be shunted while away on leave to a far off Presidency—Madras. We hear he has been posted to the Kurnool District—which is one of the least attractive parts of that Presidency. A worse fate could hardly have befallen an officer who had earned a severe censure from Government.

**FORMATION OF A COMPANY OF SAPPERS AND MINERS IN BURMA.**—The sappers of the company will consist of Burmans, Shans, Cachins, and Karens, and at least one-half of the soldiers enlisted should be fairly skilled artificers. Men enlisted as artificers will receive the same rates of working pay as are allowed to the sapper artificers of the Bengal Corps. Men enlisted as ordinary sappers will, until they qualify as artificers, receive working pay at the first rate under the rules generally applicable to the Native ranks in corps of sappers and miners.

**COMMUNICATIONS IN MALABAR.**—In Malabar the difficulty of making and maintaining roads lies, not in the spreading of metal and gravel, but in the maintenance of thousands of bridges and culverts. It is worthy of mention that the District Boards' income rises as the bridges fall, and falls as the bridges rise. When a bridge falls a ferry is established; the ferry rates are generally double the rate of tolls under Act V. of 1884, and foot-passengers pay. When the bridge is rebuilt, carts pass at half the ferry rates and foot-passengers pass toll-free.

**SCIENTIFIC AND USEFUL.**—Efflorescent salts occur in nearly every district in India. When the salt is alkaline in its nature, the surface of the soil, on which it collects, is known as dhobies' earth; and this earth has been used for ages for washing, dyeing, and in the manufacture of soap and glass bangles. A large quantity of the *reh* efflorescence of Northern India which is collected and sold in the bazars under the name of *sajji mati*, is a mixture of salts, where very often the sulphate and chloride of sodium preponderate over the carbonate.

**RANIGANJ FIRE-BRICKS.**—We regret that our remarks in our issue of the 13th October last relative to this product

are liable to misconstruction. Our object was to expose the folly of importing fire-bricks into Calcutta when the locally manufactured article was so good as to create a demand from outside. As a matter of fact, however, we find that the imports of fire-bricks have considerably fallen off in late years, and bid fair to decrease further. This is unquestionably due to the more extended use of Raniganj fire-bricks which have been pronounced equal, if not superior, to those of English manufacture.

**THE MADRAS WATER-WORKS SCHEME.**—Sanction has been accorded by the Government of India for the extension and improvement of the Madras Water-Works Scheme at a cost of thirteen lakhs of rupees, as submitted by Mr. J. A. Jones, M. Inst. CE., FRSE., the Vice-President and Engineer of the Madras Municipality. Filter beds are to be constructed for purifying the water before its discharge into the main pipes for distribution, and other improvements will also be made. On completion of the work, the water tower in bed of the Red Hills lake, which was erected three years ago at a cost of Rs. 75,000, will be utilized.

**STRANGE ARE THE WAYS OF GOVERNMENT.**—The *Rangoon Times* tritely observes that the public asked for a prospector, a mineralogist; the Government, probably not knowing the difference, tore Dr. Noetling away from his revellings in the flora and fauna of lost worlds, sent him up to Mandalay, and now expects him to report on the mineral wealth of Upper Burma, and the public to be satisfied with his lucubrations. This is hard on all parties: but we understand that a qualified man is now on his way out, when the Palæontologist will return to his old loves, and we shall cease grumbling for a time. A Palæontologist! They might as well have sent a numismatist.

**ROYAL ENGINEERS.**—The following rules are applicable to all continuous service Royal Engineer officers who may be permitted to proceed to England for a course of instruction at Chatham, under the provisions of clause 176, India Army Circular 87:—The period passed at Chatham does not interrupt privilege leave previously earned, but it does not count for further privilege leave.—II. Privilege leave may be taken either between the date of giving over charge in India and joining at Chatham; or between the date of leaving Chatham and embarking in England for India.—III. In the first case the officer will pay the expenses of his journey to England; and in the second case from England.

**A SPECIAL X'MAS CATALOGUE.**—We are in receipt of Messrs. P. Orr and Sons' most recent illustrated price list of goods in the different departments of their large and well-known establishment on Mount Road, Madras. The feature in this Catalogue which elicits this notice is the fact that the illustrations are almost exclusively drawn and blocks cut in Messrs. Orrs' own workshop. We know that they may be improved upon, but in our opinion they compare favorably with many of the same class in England. There can be no question that, with the large manufacturing resources they have at command, the firm possesses unusual facilities for meeting various demands satisfactorily.

**FAMINE RELIEF IN NATIVE STATES.**—The continued silence of the Government of Bombay in regard to the condition of the distressed districts and to the measures which are being taken for their relief, is declared by the *Bombay Gazette* to be inconsistent with the spirit of the



rules provided in the Famine Relief Code, in which it is stipulated that detailed statements of the condition of affairs shall be issued weekly. The same paper says that the absence of this information encourages the propagation of misleading intelligence, as well as the concerting by private organizations of ill-advised measures for the relief of distress. The Government, moreover, do themselves great injustice by thus withholding information. The notion prevails in many quarters that the Native States are always more prompt in their famine relief measures than the British authorities.

**SIR F. ROBERTS' TOUR.**—The Commander-in-Chief with General Chesney, Colonel Sandeman, and the Headquarters Personal Staff, visited Khojak on the morning of the 13th instant, met Mr. Elliott at Shalabagh, inspected the boring operations of the tunnel, and then proceeded by rope Railway to the top of the Khojak; thence rode to Chaman and visited the site proposed for a station, returning on horseback to Shalabagh; thence by rail to Quetta, arriving there in the evening. The progress made during the year on the tunnel was pronounced remarkable. Mr. O'Callaghan and his staff have done wonders. It is expected that the tunnel will be completed before two years. It is understood that Mr. Townsend's proposal to use crude petroleum as fuel will be accepted, as calculated to effect a saving of something under five lakhs of rupees. The progress generally since last November is marvellous.

**THE GREAT WESTERN OF INDIA RAILWAY.**—The following is from the *Civil and Military Gazette*:—"A first result, we learn, of the reconnaissance now being made by Mr. H. Bell for the Great Western of India Railway project, is that it is not possible to construct, or perhaps we should say to maintain, at any reasonable cost, any kind of Railway through the Sind desert west of Jeysulmir. The country, it appears, is a waste of sand hills of great height in places, and of such a nature that neither cuttings nor embankments could be kept in order during the very strong S. W. monsoon. Mr. Bell is now, we understand, going over the Umarkot-Pachbadra route, but is not very sanguine about this. The failure of the Jeysulmir route must, we suppose, put an end to the project for a line through this point and Bikanir from Delhi; but if the Pachbadra route should be practicable, there is still hope for Karachi being joined by rail to the North-West Province."

**PETROLEUM IN THE PUNJAB.**—The operations of the Punjab and Oriental Oil Company are so far of a preliminary nature, but it is understood that machinery for sinking oil wells in the Rawalpindi District is on its way now from home. The importance to the country of "striking oil" may be gleaned from the fact that, on the North-Western Railway alone, 200,000 tons of fuel are consumed annually, the cost of which is about Rs. 13 per ton, or 26 lakhs of rupees. If oil-fuel can be obtained, it will certainly cost less than half this; so that in the one item of locomotive fuel, a saving of 15 lakhs of rupees may be expected yearly. The cost of fuel on the East Indian Railway is only Rs. 1½ per ton, and to this, in a great measure, may be ascribed the favorable results obtained in working that line. It may not be rash to anticipate that a good find of oil suitable for lighting and fuel would revolutionize the trade of Upper India, not only by creating a large export trade to other Provinces, but by cheapening the cost of Railway transit to Karachi; thus stimulating the wheat traffic, on which the prosperity of the agriculturists so largely depends.

## Current News.

MR. CREEGEN, Agent and Engineer-in-Chief, Indian Midland Railway, has returned from three months' leave to England.

THE Mill Industry in Bombay is particularly flourishing and between twelve or sixteen new mills are soon to be erected.

THE Hyderabad Assigned Districts cotton forecasts, shew the probable outturn to be considerably above the last year's average.

MR. SYDNEY HUTCHINSON, A.M.I.C.E., we learn, has been appointed Meteorological Reporter of Western India in the place of Mr. F. Chambers.

SIR CHARLES ELLIOTT has changed his tour programme. He will now go from Fyzabad to Gorakhpur, Sonapur, and Mozufferpur, reaching Calcutta on the 27th instant.

It is proposed to extend the Inland Steam-vessels Act VI. of 1884, to the whole of Upper Burma, except the Shan States, with effect from the 1st of December 1888.

ALTHOUGH the public have the assurances of the Government that there is no longer any fear of severe scarcity in Orissa, the troubles in Bengal are by no means over.

ORDERS have been received from the Lisbon Government for the construction of a new palace for the Patriarch Archbishop of Goa, the cost of which will amount to a lakh of rupees.

HEAVY rain has fallen at Kathiawar and Guzarat, and the Bombay Agent of the Bhowanagar State is offering to send back the famine-stricken poor who left that State for Bombay.

THE area under rice cultivation in the ten chief rice-producing districts of Burma is now estimated at 3,602,766 acres, or 127,199 acres more than the area actually under cultivation in 1887.

MESSRS. JARDINE, SKINNER AND COMPANY, of Calcutta, are reported to have purchased silk cocoons, worth about three lakhs of rupees, from the Bhaugulpore District, for transport to England for the manufacture of silks there.

THE Lahore paper believes that the labors of the Public Works Accounts Committee have already brought the members to the opinion that there is a great deal too much of precise formality in the work expected of officers in the Public Works Department.

THE enlargement of the Colombo Cathedral is rapidly approaching completion, and it is expected that, with the exception of laying down the new tiles which have been ordered from England, the building will be ready to be opened by the end of the present month.

THERE is now every likelihood of the Delhi water-works being put in hand immediately and carried through to completion. Application has been made to Government for the services of an experienced Engineer, and as soon as this appointment is made work will begin.

ON arrival in India, the undermentioned officers of Royal Engineers are attached to the Military Works Department and posted as follows:—Lieutenant F. E. G. Skey to the Meerut Command; Lieutenant P. J. F. Macaulay to the Sirhind and Lahore Command.

THE Agent and Chief Engineer, Mr. Furnivall, has returned to India with instructions to defer further operations as regards the construction of the proposed line to Raipur or Aurangabad for some time to come. The plans and estimates that were in the course of preparation have therefore been abandoned.

MR. J. W. BUYERS, the Manager of the Burma State Railways, went up the Tounghoo-Mandalay extension line to inspect and push on the works in order that the line may be open for traffic by 1st January. We hear he intends going on to Mandalay in order to set on foot the operations for the Moo Valley survey.

THE Forest Department in the Central Provinces is to be strengthened with as little delay as possible. The Chief Commissioner is of opinion that "the district arrangements will never be put on a satisfactory footing, and business will not be promptly and efficiently disposed of, until the Conservator is relieved of some of the burden of office work under which he is at present crushed.



## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

### THE PRESENT STATE OF THE INDIAN P. W. D. AND ITS PAST HISTORY.

#### IV.

SIR,—Looking back at the history of India during the past quarter of a century, nothing strikes the observer so much as the vast development of public works which has taken place during that period, and the great changes in the social, political, and administrative life of India, brought about by their agency. In 1857, there were only some 273 miles of open Railway as against 10,784 miles in 1884, which has since been largely increased. During the same time the total imports had risen from £28,610,000 to £68,160,000; and the exports, which were £4,790,000 in 1854, had risen to £20,940,000 in 1884. In India nearly all the great public works are constructed by Government through the agency of a large department, whose growth may be judged of from the fact that the gross annual expenditure under this head, which was only £4,340,000 in 1857, had increased to £18,610,000 in 1884, thus exceeding the total expenditure on the Army in that year by over one and-a-half million, and forming over 26 per cent. of the total annual expenditure, which in that year amounted to £70,340,000. But unlike expenditure on the Army, which in a certain sense is a dead loss to the State, and an inevitable burden that has to be endured, we find that so far from this being the case with Public Works expenditure, it is a direct and increasing source of revenue to India. In 1857 the total annual revenue from Public Works was only £920,000. This had risen to £14,120,000 per annum in 1884, at which time it formed 19.5 per cent. of the total revenue of India, that in the latter year stood at £71,731,000. It is too much the habit of a certain class of Anglo-Indian officials to say that we rule India by the power of the sword. There cannot be a more misleading phrase than this, for if we have been able to do any good in India, it has been by the inculcation of principles of truth and justice into our administration, by education, by the cultivation of the arts of peace, and by the development of the resources of the country.

This has been brought about and rendered possible in a great measure through the agency of the Public Works Department, which however criticised in the detail of its working, and the undoubtedly cumbrous nature of some of its machinery, yields to none; no, not even to the Heaven-born C. S. itself in the magnitude of the results it has secured for India.

The Civil Engineers are, owing to the varied recruitment of the department, divisible into six different classes all under varying rules as regards leave and pension, and all, in spite of reiterated promises, very differently treated from the Royal Engineer.

The leading differences between the emoluments of the Royal and the most favored class of Civil Engineers are—

#### ROYAL ENGINEERS.

(a) Are under no obligation to elect for Indian service till they have completed four years in that country.

(b) After electing for continuous service in India, they can still in event of distaste for the work, ill-health or other cause, exchange with officers on the Home Establishment. If placed on half pay or retired from the Military Department, they can still remain on in India on Civil employ.

(c) Service for pension is from date of 1st commission including all service on half pay effective or retired list, at home or elsewhere, also the two years of training at Chatham.

(d) Three years' British service in addition, all leave out of India (however long) counts as service for India pension.

(e) Draw in addition to the Civil pay of their rank Military pay as under:—

Lieutenant Rs. per month	..	70	0
Captain	..	140	0
Major	..	180	0
Lt.-Colonel	..	243	8
Colonel	..	304	6

(f) Draw on furlough a minimum pay of 250 Pounds sterling per annum and £500 above Executive Engineer 4th grade.

#### CIVIL ENGINEERS.

No corresponding advantages are possible.

Service for pension counts from date of leaving Cooper's Hill and includes at most one year's English training.

A maximum of four years only counts for pension out of all leave, including sick leave, and furlough during entire service of 30 years.

Do not draw any additions to their net Civil pay.

Pay on furlough is half pay at current exchange. There is no minimum. Some officers would now after 10 years' service draw £180 a year if sent home sick.

#### ROYAL ENGINEERS.

(g) Have a widows' and orphans' Fund.

(h) Retire on pensions as under:—

After 20 years' service ...	£250
" 24 " " "	£365
" 28 " " "	£500
" 32 " " "	£700

#### CIVIL ENGINEERS.

Have a provident Fund to which all must subscribe, but without State aid other than management of the Fund.

Can retire on pensions as under:—

After 20 years' service Rs. 4,000*	
" 25 " " " 5,000*†	
No corresponding pension.	
No corresponding pension.	

† Subject to a possible grant of an additional pension of Rs. 2,000 (£133-6-8) and Rs. 1,000 (£66-13-4) for Chief and Superintending Engineers respectively.

All are paid in Rupees.

\* Equal at present exchange £260 and £333.

These inequalities are glaring enough, but these are not the only inequalities in the Department. The Civil Engineers numbering about 708 are made up of—

- (1) "Stanley" Engineers engaged by the Secretary of State.
- (2) Cooper's Hill Engineers including some natives of India.
- (3) Appointed in India by the Indian Government with English experience.
- (4) Appointed in India from the Indian Colleges prior to 1st April 1876.
- (5) Appointed similarly since 1st April 1876.
- (6) Natives of India appointed in India.

Class (1) Counts its service from date of landing in India and not from date of appointment thereby differing from

Class (2) Which counts its service from date of leaving the Cooper's Hill College. Both are under the same leave and pension rules, namely, 2 years furlough in 20 years counting as service for pension and one year's furlough not counting as service for pension, after each 4 years' of service. Furlough pay is for both half pay at current exchange, and pension after 20 and 25 years service is Rs. 4000 and Rs 5000 respectively

Class (3) Has under Resolution Govt. India 449, dated 18th April 1884 been admitted to the same pension rules, but not to the leave rules.

Class 4 Has the general U. C. S. pension and leave rules."

Although prior to the Government of India order dated 1st April 1876; they were admitted to the service without any information being given them that they would be differently treated to classes (1) and (2). when those classes were admitted to improved furlough and pension rules class (4) were excluded, although many of them are undoubtedly of English domicile and had never received any notification that they would be differently treated to other European Engineers.

Class (5) Stands in the same position as class (4) with this difference that entering subsequently to the order referred to they entered with their eyes open.

Class (6) May for the present purpose be left out of account. As a class it is not contended even by themselves that they are the equals in experience and professional attainments of the European Engineers. Their leave and pension rules are, for men serving in their native land, liberal, and this is evidenced by the large supply available.

There is no Civil Engineer on the Council of the Secretary of State—as a Secretary to the Government of India—as a Secretary to any of the Local Governments—as a Consulting Engineer for Railways—or Director General of Railways, and as it is on these officers alone that Government has to depend for advice and opinions on all matters concerning the Department, it is only just that a certain proportion of them should be Civil Engineers, and not all Royal Engineers, as at present.

The proportion of Civil to Royal Engineers in the Department is more than three to one, so that at present practically the great bulk of the Department has no means of getting their views put before Government, for without wishing for a moment to impeach the good faith of the Royal Engineer advisers to Government, yet it is impossible but that their opinions and feelings must, in controversial matters, lean in favor of their brother officers. On this question it may be noted that when a few years ago it was considered advisable to form a "Consulting Engineer for Railways" Department, Government was advised to reserve the whole of the head, or "Consulting Engineer" appointments for Royal Engineer officers—many of the officers in consequence appointed to the Branch were lacking in any special Railway experience, while at the same time there were many Civil Engineers in the Department, who had been employed on Railway work all their lives and well qualified for the Consulting Engineer appointments.

It is absurd to suppose that the Government of India, represented in the D. P. W. by men with interests antagonistic to the Civil Engineers should have the interests of the Civil Engineers at heart.

If this was really the case endeavours would be made to take the sense of the Department on the various questions from time



to time raised. Collective memorials are not allowed, however courteously and properly worded, and matters of vital importance to the C. E. are discussed with closed doors, his exclusion being carefully enforced.

Under such circumstances is it to be wondered at that discontent should be so widely spread in the Department.

We have now reached this point that there are in the Department called upon to perform the same duties

145	Military Engineers
466	Civil Engineers appointed in England
68	Civil Engineers appointed in India (English trained)
155	Civil Engineers appointed in India

834 Approximately

That assurances have been given by the Government of India and the Secretary of State that the European Civil Engineers shall have equal treatment with their military brethren, notwithstanding which all the above mentioned disparities exist. There is however another aspect of the question which we, dealing with the history of the *personnel* of the department have not as yet touched upon, it is this. In the Provincial branches more especially the ratio of Establishment to new works is absurdly large, reaching in one instance, which we recently gave, the figure of 110 per cent. It is needless to multiply instances; the fact is a patent one and has been recorded by the Public Service Commission. Under these circumstances, however, it is clear that a Re-organization scheme which, simply urges Government to aid the seniors to retire for the benefit of the juniors by offering £400 and £500 pensions at the end of 20 and 25 years' service, and so add to the already overgrown cost of Establishment is neither economical nor just to the taxpayer. Moreover, judging from the fact that Government were empowered by the Secretary of State to apply the 50-year rule in 1883, and did so with great reluctance in 1887, such a concession is most unlikely. Indeed, looking at the question all round it seems that the Government of India cannot be expected to increase the burden of the P. W. D. Establishment in any considerable degree.

VERITAS.

#### ERRATA.

SIR,—In Article I. "Irrigation in the Punjab" the top line of right column should read thus:—

Actual receipts realized from Miscellaneous sources during			
1886-87	...	...	Rs. 1,15,270
Original Estimate	...	...	" 81,000
More than	"	...	" 34,370

In the 11th line from the foot of same page 311 for "Milpulls" read Tailfalls

In Article III., page 350, for Kuttur read Kuttora and for Hurra read Hurreeke.

E. B.

#### INFORMATION WANTED.

SIR,—Can you or any of your readers kindly give me information on the following points:—

1. When and where Colonel Jacob's Port folio of working drawings of Indian architecture will be published, and to whom subscriptions should be sent?
2. Area of waterways for Indian Rivers: Colonel Dicken's formula works well for large areas taking constant at 825; but what formula is the best to use for calculating small areas?
3. What are the qualifications for District Engineers prescribed by Government and published in the *Calcutta Gazette* of the 16th March 1887, I.B., page 79. I have tried, but unsuccessfully, to obtain a copy. Will you quote the ruling or inform me where to obtain a copy?

M. S. E.

#### IRRIGATION IN AUSTRALIA.

SIR, I have just returned from a short trip to Australia and was much interested in what I heard while in Melbourne of the Chaffey Brothers big Irrigation scheme. My time in the colonies was so short, only a month altogether, that I had not an opportunity of going to Mildura or Renmark to see the irrigation operations, much as I should have liked it: nor could I get much information as to the Engineering details of the scheme. As far as I could learn, they are going to pump the water by three centrifugal pumps driven by steam, the water so raised is to be distributed by concrete channels and iron pipes and will be delivered at the highest point of each 10 acre block.

I send you a copy of the Chaffey Brothers' very elaborate book,\* advertising the project. The views of Melbourne are very good

If I could have got any particulars on the spot I would have written you an article on the subject: perhaps you may like to notice the scheme in your paper. From the book I send you and one or two prospectuses enclosed in it, you will be able to learn as much as I know myself about it. I don't know what the opinion of the knowing ones in Melbourne is as to the advantages of the scheme as an investment. On paper it looks like a pagoda tree. The results of irrigation in a suitable climate are very wonderful: *vide* Sind.

November 13, 1888.

BOMBAYITE.

#### MOORE'S IMPROVED CAST-IRON SLEEPER.

SIR,—As "G. E. M.," in your issue of the 27th October, asks my reasons for supposing that his sleeper will break in the centre, I may mention, that about five years ago a cast-iron sleeper with a fixed outer, and loose inner jaw, was designed and tried, but not patented. In shape it was not unlike the D. and O., but the rail, instead of being suspended, rested on the plate. They were carefully packed under the personal supervision of the designer, but all broke under the rail, and the marks clearly proved that the damage was done by the rail moving up and down, as trains passed over the line. The loose jaw had at least four times as much grip on the rail as the T-iron tie bar of Mr. Moore's sleeper, but still it failed to keep the rail steady.

The Barlow Chair Sleeper, and even the ordinary chair, also break in the centre, if the wooden keys are not kept tight, and it was chiefly on this account that the former was condemned, although it had many good points.

Personally, I object to any sleeper that is trough, or cup shaped, although inventors, in Europe, evidently are of opinion that sleepers of this class are superior to those made flat with a centre rib, as they give more hold on the ballast. This is perhaps correct, but is it an advantage, and is it necessary in this country where the ballast is never more than 2 inches below rail level? Experience has proved that there is no difficulty in keeping the road in proper alignment with D. and O. sleepers, and they can be packed better and quicker than any hollow sleeper.

I quite agree with G. E. M. that experience is the best test, and I would like to see his patent tried. Still, unless I am very much mistaken, I think that he will find that the rails will rock more in his sleeper than they do in the D. and O. As a matter of fact, these last do not require packing so often as wooden sleepers; I saw some lately—on a portion of the line where many heavy trains run—that had not been touched for 21 months, and they did not appear to require repacking.

RAILROADER.

#### THE ACCOUNTS BRANCH, P. W. D.

SIR,—A Committee has been appointed, so far as I can make out or understand, to inquire and ascertain what particular Forms of Accounts might be dispensed with in Executive Engineers' Offices. This, however, is not by any means what is really required at all. One member of the Committee at least could tell off his tongue what particular Forms are really necessary, and what others might be safely dispensed with. I allude to Colonel E. Harvey, R.M., than whom there is not another officer in the whole P. W. D. who is so thoroughly conversant with the present system of accounts.

But here as usual the Government are on the wrong scent altogether. They wish to effect economy, yet do not know where to begin, or rather where to apply the shears. Knowing something of the past and present systems of the Public Works Accounts permit me to offer a few suggestions to effect a very material economy and that, too, without in the slightest degree sacrificing efficiency.

In the good old days "Lang Syne" the Provincial Chief Engineers audited the accounts of their respective charges. To assist them to do this they had Head Accountants (one to each Province) with "Branch Accountants" for each circle of Superintendence. These again had a few Accountant Clerks to assist in the preparation of the Provincial Accounts, which when so prepared were (if I remember rightly) forwarded not submitted to the Civil Accountants-General of Provinces. The foregoing is a rough, but I believe quite accurate sketch of the old system of audit.

The present system is much more elaborate, indeed a great deal too much so to endure for ever. The present system was introduced in 1859 and has enjoyed therefore a career of twenty-nine years. I have no doubt whatever but the present colossal dimensions it has attained have far exceeded anything its talented founder, now a member of Council, ever anticipated. Someone has, however, sagely observed that Secretariats have a tendency to expansion. The present Accounts Branch consists of ninety-two officers and a host of Accountants which are "too numerous to detail," or even enumerate with any probability of accuracy. These superior officers are divided and sub-divided in Accountant-General, two Deputy Accountants-General, eighty-five Examiners, Deputy Examiners, and Assistant Examiners; and to bring up the rear, there are four "Apprentice Examiners." Of the

\* A handsomely bound and illustrated volume.—Ed., J. E.



foregoing, nine are officers of the Corps of Royal Engineers, ranging in Army rank from full Colonel to junior Lieutenants, four are officers of the Staff Corps, two are Civil Engineers under what is called "special covenant," while no less than seventeen blooming youths are Civil Engineers from that mine of talent, Cooper's Hill.

Now, if these gentlemen had even the most remote idea of the meaning of "Esprit de Corps" they would consider it beneath their dignity to sit down in their chair of Accountant at all. This remark specially applies to the officers of the distinguished Corps of Royal Engineers. The idea of a junior Lieutenant of this distinguished Corps, coming straight from Chatham to Simla and settling comfortably down in the seat of an Accountant is so rich that it could not possibly be omitted in writing of the Accounts Branch. It must, however, be admitted that this young gentleman has commenced his "Military Career" with extreme caution, and if he adheres to the same cautious line of policy to the close of his service he will return home with a breast as innocent of honours as his talented fathers did before him. The proper sphere for this junior subaltern of R. E. would be at the present moment under Colonel Beresford Lovett, C.S.I., R.E., on the Black Mountain, but no such absurd idea ever entered his peaceful head. Simla is very much preferable to the air on the Black Mountain. This, however, is a serious digression, and can only be explained by a desire to shew what extremely comfortable billets there are in the Accounts Branch of the P. W. D.

The remedy for this state of affairs is short, simple and effective. Abolition pure and simple, complete and wholesale of the present overgrown and unwieldy Department is the only possible reform of a branch of the Indian administration for which there is not even the shadow of excuse for retaining.

The work can be done much more efficiently by a staff of probably one-tenth the present number at a proportionate saving to the State.

One Head Accountant with six of the present Accountants of the first and second grades with one Clerk attached to each Provincial Accountant-General would complete the whole accounts, Civil and Military, of the Province much more expeditiously than is now the case with the whole of the expensive and unwieldy machinery employed.

E. B.

## Literary Notices.

NOTES ON A SYSTEM OF STANDARD DETAILS AS APPLIED TO THE CONSTRUCTION OF ROLLING STOCK ON RAILWAYS IN INDIA. By *Everard R. Calthrop, Assistant Locomotive Superintendent, Great Indian Peninsula Railway.* Bombay: Printed at the *Times of India* Steam Press. 1887.

MR. CALTHROP'S notes on a system of Standard Details as applied to the construction of Rolling Stock is a well thought out and carefully written book and one which every Loco. Superintendent might study with advantage, and place in the hands of his District Officers with instructions to read, mark and learn.

The main principle of the system is, that every detail part or unit which goes to make up the Rolling Stock, whether a locomotive, a carriage or a wagon should be carefully thought out, and when once the form is found which is believed to be the most suitable for the work for which it is intended, that design should be stereotyped and become a standard, and a drawing of the article together with a written specification of the stores required for its manufacture registered in the drawing office as a Standard Detail.

This idea in itself is nothing new, and is only what every Locomotive Superintendent is likely to strive after, but the author has gone very fully into the details as to how this desirable principle may be brought about, and his Indian experience and evident knowledge of American practice has made his notes valuable.

The author brings forward some very strong but reasonable arguments to shew that, with a system of Standard Details the cost of new, and repairs to old stock can be much reduced, and that the system enables a fairly accurate forecast to be made of the repairs and renewals likely to be required after any fixed period, which is a point of much importance to a Locomotive Superintendent who has to obtain the bulk of the stores for such renewals from England.

Mr. Calthrop touches on a matter which has hitherto not received the attention of Indian Locomotive and Carriage Superintendents which it deserves, when he says:—"The consummation of achievement to be attained by the Locomotive Department

of a Railway, as regards the maintenance of rolling stock, is to keep the largest possible percentage of stock of all kinds constantly available for traffic. If stock under repairs is detained for traffic 50 per cent. longer than is necessary and the average proportion under repairs reaches 25 per cent., it is clear that the line could be worked to the same efficiency under the more favorable conditions, with a smaller total of rolling stock equal to 91½ per cent., or the same rolling stock would become as efficient as if it were greater and equal to 108½ per cent."

His proposal, however, to do the larger portion of repairs while the stock is running, to quote his own word is startling, and the method he suggests is as follows:—

That as it is the moving portions of the stock that require repairs most frequently, that those parts when damaged or worn, should be at once replaced with new and the old parts brought in and repaired at leisure.

This practice could not of course be carried out at all, unless the different units or parts which make up the stock were originally of standard dimensions, and although it is doubtless economy to keep rolling stock going as long as possible, still it is doubtful whether the practice of putting in new parts piecemeal into a locomotive or a carriage would in the end be true economy. It must not be overlooked that most of the wearing parts of rolling stock generally, and locomotives in particular, have arrangements for taking up or adjusting the wear and tear, and that these parts after working or running together become adapted to one another, and although originally of the same standard dimensions will not fit others. For instance, suppose a six wheel coupled engine required her tyres re-turned under the system proposed; a new set of wheels would be furnished and the actual work of taking out the old set and putting in the new set would perhaps take a day or so, whereas if the engine was laid up while the old wheels were turned, the repairs would take probably three or four days. On the face of it, this it would appear to be a saving when every engine was required, but it must be remembered that if a new set of wheels was put in, the probabilities are that the axle bearing brasses, the coupling rods, the big ends and eccentric sheaves, &c., &c., although originally of standard dimensions, would through wear not fit the new set of wheels. There is no doubt that a liberal reserve of duplicate parts is a satisfactory and economical way of keeping stock in running, but it is a system which has been already much abused in India.

We have reason to know that the home authorities have recently called attention to length of time that stock in India is laid up for repairs, and the large percentage laid up. Now, after making allowances for speed and facilities for repairs &c., there is no doubt that the mileage we obtain out of our rolling stock compares very unfavorably with American and Continental returns. We think, however, that the home authorities may fairly take a large proportion of the blame for this to themselves, as the main reason for the protracted periods that stock in India is laid up for repair, is due to original faulty and unsuitable design, and the difficulty of procuring stores or material for the repairs. The system advocated by Mr. Calthrop might well be considered by the home authorities.

As we have said, a system of standard dimensions is one that every Loco. and Carriage Superintendent would gladly carry out, but the legacy that most Superintendents have to take over of as many different classes of engines, carriages and wagons to do the same work as there are letters in the Alphabet is a very serious obstacle in the way. This legacy is the result of amateur ideas of rolling stock, and the wonderful ignorance of the requirement of the country, that the Consulting Engineers at home have shewn in past years. However, these are more enlightened days and the new Railway Companies will doubtless see that it will pay the shareholders best to allow the Locomotive Superintendent to ask for what he wants in the way of rolling stock, and he will then be able to adopt and maintain a uniform system which is true economy, by whatever name it is called.



## General Articles.

## MADRAS LIGHT-HOUSE.

It having been suggested that an account of the Madras Light-house would be an appropriate accompaniment to the articles that have recently appeared in this Journal on the Light-houses in Burma, we are induced to furnish the illustrations annexed with the following particulars:—

<i>Name of Light</i>	... "Madras."
<i>Location</i>	... On Esplanade, north of the Fort,
<i>Position</i>	... Latitude 13° 15' 11" N. Longitude 80° 16' 51" E.
<i>Color of Light</i>	... White—flashing.
<i>Interval of revolution of flash</i>	... Light has five faces and every minute one face flashes towards the same spot, but three faces are presented seaward at the same time.
<i>Miles visible in clear weather</i>	... 20
<i>Height in feet of centre of lantern above high water</i>	... 128
<i>Height in feet of building from base to vane</i>	... 125
<i>Arc of illumination</i>	... 310° facing East.
<i>Nature of Construction</i>	... Granite column, lined with brick.
<i>Character and order of illuminating apparatus</i>	... Catadioptric.
<i>Year lighted</i>	... 1st January 1844.
<i>Objects</i>	... To guide vessels clear of the Pulicat shoal and into the roadstead of Madras.

The excavation for the foundations was carried down to a depth of 10 feet below the surface. Beneath this, wells 8 feet deep were sunk. The four flanking buttresses (used as store-rooms, etc.) are buildings quite independent of the shaft and its pedestal and foundations. A well 3 feet in diameter exists in the middle of these latter for the purpose of increasing the fall to be given to the weight by which the lighting machinery is kept in motion. The summit of the column is reached by a flight of 200 stone steps starting from the base. The lighting machinery was designed by (then) Captain Smith, F.R.S., of the Madras Engineers, who appears to have taken a prominent part in the design and erection of the structure. After 45 years' use, the revolving machinery was removed and replaced by new machinery in March this year. The Madras Light-house is the only light-house in India that burns cocoanut oil: all else use kerosine oil.

## BANGALORE WATER-SUPPLY.

AN ESSAY CONTRIBUTED BY A. H. GARRETT,  
*Executive Engineer, P. W. D., Madras.*

## II.

10. *Advantages of Proposed source of Supply.*—At the commencement of this paper I have tried to shew that a reservoir offers the only satisfactory means of supplying the troops in Bangalore with drinking water.

The reservoir which I have proposed would receive its water from a clean gathering ground, it would be certain of an ample supply, its first cost would not be great, and the annual expenses would be moderate.

There is, however, another point of view from which the proposed source of supply commends itself. It cannot be overlooked that there are numerous objections to the system of a dual supply of water for the troops. This idea was only started in connection with the distillation scheme, as the cost of the distillation process

made it impossible to supply more than a limited amount of distilled water to the troops. If really good water could be supplied to the troops for inferior purposes, as well as for drinking, it would be an undoubted advantage.

The present source of supply enables this to be done, and the following is an approximate estimate of the cost of the works which would be necessary:—

	Rs.
Reservoir ...	50,000
Settling Beds ...	16,500
Filters ...	20,000
Clear Water Cistern ...	7,500
Engines and House ...	40,000
Mains ...	2,00,000
Stand Pipes ...	10,000
Stand Cocks ...	10,000
Compensation ...	82,000
Contingencies ...	14,000
Total ...	4,50,000
Working Expenses ...	17,600
Interest at 10 per cent. ...	45,000
Annual Cost ...	62,600

The estimate provides for buying up the entire gathering ground above the reservoir.

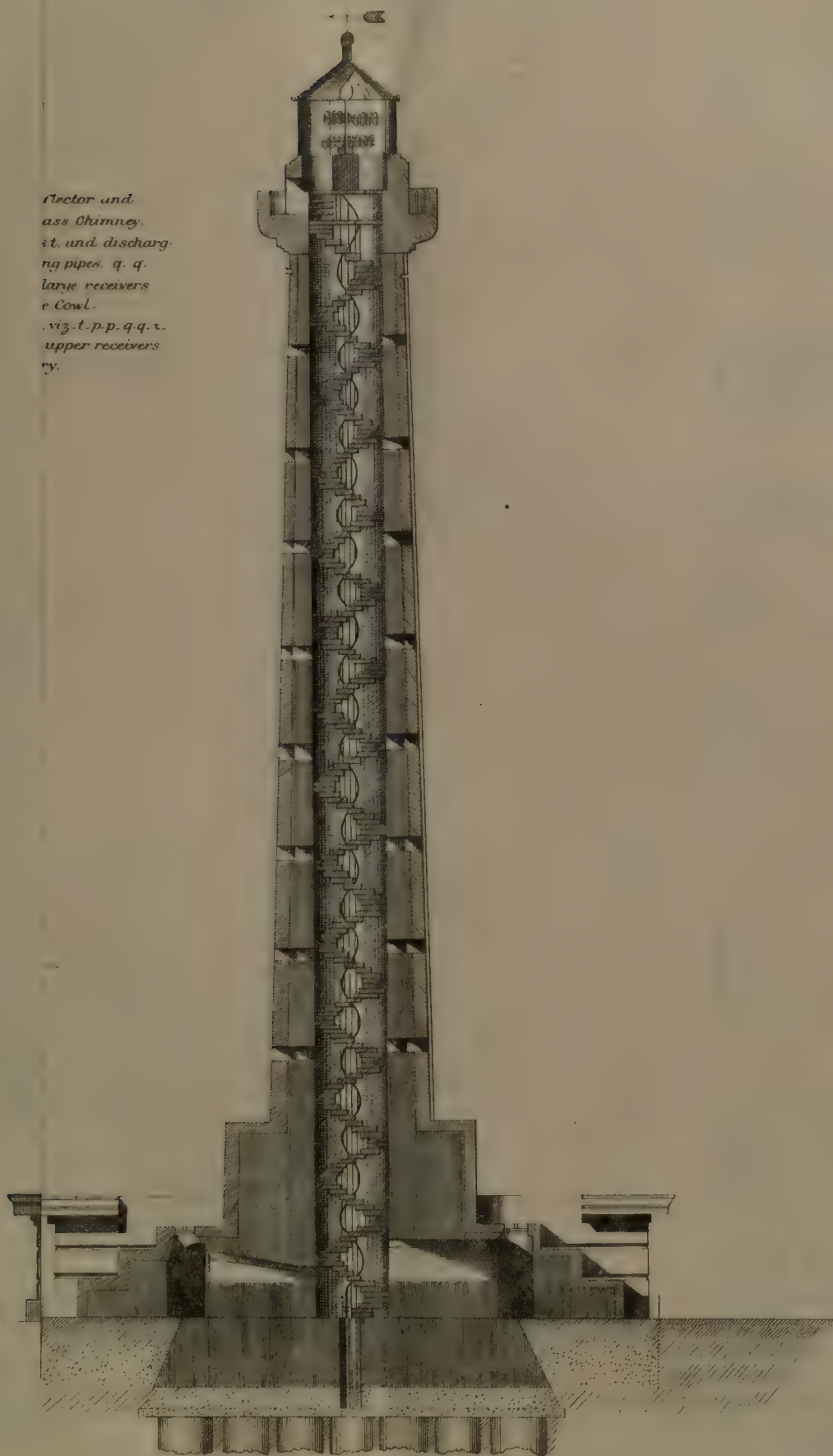
The total cost is much below that of "Project A," if compensation is allowed for the four villages whose drainage falls into the Agaram Tank.

The project is also a cheaper one than "Project B" (Annual Cost of "Project B" Rs. 84,600) the annual charges not being so high, whilst water of uniform purity is supplied for all purposes. The heaviest item in the estimate is the cost of the mains. If water was taken from the Arkavutty or Penaukeny, the cost of the mains would be doubled, so that it is unlikely that a scheme depending on either of these rivers would be as economical as the one now brought forward. It would be quite impossible to bring water from the Caveri at a cost at all approximating to that of the Sagipaliya Project.

(6.) *In conjunction with Sankey's Reservoir enables entire population of Bangalore to be supplied.*—Providing the troops with good drinking water would render of less frequent occurrence cases of enteric fever, which have of late been very numerous. But so long as the water-supply of the rest of the population is bad, the health of the troops must be in danger. An epidemic in the bazaar would be certain to spread to the garrison, whose well-being is thus in a great measure dependent on that of the native population. With the many advantages resulting from its climate and position, it is most desirable that the value of Bangalore as a military position should not be imperilled by a defective water-supply. One of the advantages claimed for the source of supply now brought forward is that, in conjunction with Sankey's reservoir, a sufficient supply could be obtained to meet the wants of the entire population of Bangalore. The daily demands of the entire population may be taken at 900,000 gallons, and after allowing for evaporation the amount required to be stored is 329·5 million gallons. In para. 5, I have shewn that the total amount available for storage from a catchment of 4 square miles is 111·8 million gallons, so that working with the same data a catchment area of 11·8 square miles is required to yield 329·5 million gallons. The total area of the gathering grounds of Sankey's reservoir, and the one proposed near Sagipaliya, is as follows:—

Sankey's Reservoir ...	2·5 square miles.
Sagipaliya ..	4·5 "
Total ...	7·0 square miles.











The Amildar of Bangalore makes the area of the catchment nearly 5 square miles. Four-and-a-half square miles is probably not too much, though in my previous calculations I have taken the catchment area to be only 4 square miles.

According to my calculations, therefore, the drainage area of the two reservoirs is short by 4.8 square miles of the area required for the supply of the whole population. But in my calculations, I have not only accepted Colonel Mullins' small proportion of yield to total rainfall, but I have also made a very large allowance for wastage.

This is not taken in account by Colonel Mullins who, in para. 28 of his report (*vide* also para. 51 of the same report), estimates the drainage area required for the supply of the whole population at 7.5 square miles, or half a square mile more than the combined drainage areas of the two reservoirs. Considering the character of the catchment of the Sagipaliya Reservoir, I have little doubt that the yield would be far in excess of my calculations, and I submit that much might be done at a comparatively trifling cost to improve Sankey's reservoir. The two causes which have chiefly contributed to the failure of this work are (1) leakage from the reservoir, (2) absorption of the rainfall before it reaches the delivery channels. The leakage could be stopped by covering the whole of the reservoir bed with a layer of concrete, and this should not cost over Rs. 50,000. To prevent the absorption of the rainfall, a system of drain pipes is required.

These pipes would be placed about 18 inches below the surface of the ground, and would be disposed in lines so as to intercept the water flowing through the porous soil, and convey it to the delivery channels. The pipes would be about 8 inches diameter: large-sized gravel would be placed round them, and over the joints fragments of larger pipes. If there was a bed of clay underlying the porous soil at a moderate depth, the drain pipes would be embedded in it, and nearly the whole of the rainfall could be intercepted.

But even when there is no underlying clay, pipes similar to those described, have been known to collect a very considerable proportion of the rainfall. Ten miles of drain pipes would probably be sufficient, and these would cost about Rs. 25,000.

At present the Ooperhalli reservoir, although 5½ lakhs have been spent on it, is practically useless. By the expenditure of Rs. 75,000 the two principal reasons of its failure could be removed :—

Concrete Floor...	...	...	50,000
Drain Pipes	...	...	25,000

Colonel Mullins' Report, para. 5-7.—The cost would be well under Rs. 50,000, as the amount of water to be distributed would be far less than that for which the distribution works were originally designed.

To complete the distribution works would cost, say, Rs. 50,000, so that the total cost of making the reservoir capable of taking its proper share in the water-supply of Bangalore would be Rs. 1,25,000.

The cost of the Sagipaliya Project, if 60,000 gallons a day were to be supplied, would be Rs. 4,50,000 (*vide* para. 10). About 2 lakhs would have to be added to this for increased cost of mains, engines, &c., if the supply of the whole of Bangalore was attempted.

The total cost of the project for the supply of the entire population would thus be as follows :—

			Rs.
Sankey's Reservoir	...	...	1,25,000
Sagipaliya Reservoir	...	...	6,50,000
Total	...	...	7,75,000

If this outlay were incurred, it is believed that even in bad years there would be a sufficient quantity of water to meet at any rate the essential wants of the entire population. Without making use of Sankey's reservoir, it would be impossible to bring forward a

scheme involving so low an expenditure. The cheaper of Colonel Mullins' two estimates for the supply of Bangalore from Nundydroog amounts to Rs. 24,87,000, or more than three times the cost of the Ooperhalli-Sagipaliya Project.

The drainage area available at Nundydroog is only 9 square miles, or two more than the combined areas of the Ooperhalli and Sagipaliya reservoirs. From the map it would seem possible to add about 2 square miles to the catchment of the Sagipaliya reservoir. Could this be done, there would, I think, be no doubt about the promising nature of the project.

11. Summary.—The conclusions arrived at are as follows :—

- (1.) That a reservoir affords the best means of supplying the troops in Bangalore with pure drinking water.
- (2.) That as none of the tanks round Bangalore are suitable sources of supply, a new reservoir will have to be formed.
- (3.) That there is an excellent site on the Magadi Road, about 6 miles from Bangalore, where a reservoir could be constructed from which the troops could be supplied with pure drinking water at a moderate cost.
- (4.) That the same source of supply would furnish the troops with a sufficient quantity of pure water for all purposes.
- (5.) That the Sagipaliya reservoir, together with the one at Ooperhalli, would yield a supply sufficient for the requirements of the entire population of Bangalore at a cost which must be considered extremely low.

A. H. G.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.  
XXXIX.  
Whitewashing one Coat.

Items per 100 s. ft. (1.)	No. or Quantity. (2.)	Rate. (3.)	Amount. (4.)	Total. (5.)
Labor.—				
Masons	No. ...	Variable	Do.	Do.
Bhisty	" ...			
Cooly	" ...			
Materials.—				
Stoneline (quick) lb. ...	1	...	...	...
Sundries, brush, cloth gum, &c. ...	...			
Petty Establishment ...	...	...	...	...

Note.—5½lbs. quicklime made 5 gallons of whitewash of proper consistency, and covered 1,062 superficial feet one coat. For new white washing four coats at least are necessary. For renewals two coats suffice. Working rates can be deduced for new or old work from foregoing details.

THE PRODUCTION OF COAL IN FRANCE IN THE YEAR 1887 amounted to 21,403,049 tons, an increase of nearly one and half millions tons on that of the previous year. The consumption has apparently not increased in the same proportion, for we find the imports in 1888 falling off, though the output has not increased in the current year in a greater ratio. The total quantity imported in the first six months for consumption in France amounted to 3,951,411 tons, against 4,074,800 tons in 1887, and 3,971,484 tons in 1886. The falling-off has been almost wholly in the trade with Belgium and Germany. Of this year's quantity, Belgium furnished 46.43 per cent; England, 44.12 per cent, and Germany, 9.39 per cent. The consumption of coke has increased, stimulated mainly by the revival in the iron trade. The imports of coke in the half-year amounted to 549,075 tons, against 507,013 tons last year, and 487,846 tons in 1886. Of this coke the Belgians sent 73.8 per cent and the Germans 24 per cent. The demand for coke still increases. Coke is now quoted from 15s. 3d. to 16s. at the pits.



## INUNDATION CANALS.

## THE RESULTS OF 10 YEARS' WORKING OF CERTAIN CANALS.

*The Stability of their Heads.*—The general opinion is that Inundation Canals are always in need of new Heads. A new Head is of course a simple remedy, but it must as a rule be a very expensive one if it is to be efficient. In the hundreds of cases with which the writer has had to deal he has not found one in twenty in which it was necessary to do more than clear the feeding creek. In the doubtful cases he has not had sufficient local knowledge to warrant him in carrying out his theory when the people concerned were willing to incur the burthen of making a new Head.

The cost of cleaning a gullet through the most heavily silted creek is obviously a mere trifle compared to the expense of making a new reach of canal through the high land. The contention of those who vote for new Heads is that the gullet is soon obliterated. No periodical systematic soundings have been taken to ascertain to what extent the gullets retain the sections to which they were excavated when the creeks fill, and they are submerged. Judging from the results on a whole series, it can be asserted that the gullets work just as well as new Heads, but it is not so easy to disprove the allegation on a particular canal that it might have worked still better if a new Head had been given.

In making the gullet the important points to be attended to are:—

I. To align the gullet along the "*wahak*" or deepest part of the creek. As in nearly if not in all cases the smaller channel's deep stream leaves the larger stream on a curve somewhat resembling B. D. E. in *fig. 2* this line should be followed, and not the apparently better line A. D. E.

II. To put the spoil on that side of the gullet where the *spill is from and not into the gullet*. In other words, on the down stream side of the gullet.

III. To start the clearance 6 or 7 miles from the Head (say at zero mile, see *fig. 1*) and work up-stream through creek to perennial stream.

IV. To allow no bunding up of creek below Head of canal. If the creek is heavily silted below, there will be a natural bund and this will ensure a good supply in the early part of the season. But even if there is a deep channel below it is safest and best in the long run to be content with the smaller supply than to run the risk of unforeseen and violent changes when the bunds give way, or get outflanked from the creek, bringing more water than the canal can carry.

V. To grade this bed of gullet as deep as possible, it should be 2 to 3 feet below spring level. Even if this involves flattening the gradient down to a dead level no harm is done.

In the case of the two canals shewn in *fig. 1* not an acre of land has been taken up during the last 10 years for a new Head. Twice in this period the main stream has been found in the Autumn in front of the Head (B) of the upper canal, and then of course creek clearance was saved. In other years the river has after the flood season left a network of creeks. The best of them was selected and cleared out to level to B. Sometimes the clearance was heavy and for a long distance (up to 6 miles in one case) and sometimes it was merely nominal—cuts through shoals to connect long deep pools of water. No attempt at training the current by stake or fascine was permitted.

The lower canal always had the creek C. D., and this creek was never perennial, but sometimes it was silted very little; at other times the whole length of about 4 miles had to be cleared to a depth of from 2 to 4 or even 50 feet.

*Levelling*—Before the annual clearances these two canals were invariably levelled from zero mile up to perennial stream, and the results plotted for record. This gave 11 to 12 miles for each canal, which at 3 miles a

day, including plotting, employed a leveller 8 working days. The longitudinal section shewed position of holdings, flow gaps, depth of spring level, &c. The names of the holdings on the banks were an additional precaution in case of any confusion or error in numbering the pegs. Everything depended upon levels and clearance above zero mile being correct. If the water got along to zero mile all right it could not go back; so all below was a mere matter of detail. A mistake below was not a vital one. It is obvious that permanent marks to chain to in the creek were an impossibility, and that levelling from zero mile was no great task. It was absolutely necessary to do so to alter grading to suit varying lengths to perennial stream above.

*Silting.*—The Inundation Canals are credited with great powers of silting. The records of these two do not shew that they are worse off in this respect than permanent canals. In some cases they are better off, probably because the changes in velocity are more violent on the permanent canal from river to canal and from canal to regulator.

*Flood Regulator.*—Arrangements had been made to construct a Flow Regulator for the lower canal about 3 miles below D. On the writer objecting the work was abandoned and the contractor compensated. It is obvious that a Regulator here, when closed, would convert the beach above into a stagnant pool which would soon silt up. The people would prefer the partial losses due to floods to the wholesale drying up of their crops from the canal silting up early in the flood season. The flood waters were managed by allowing them to spill freely over left bank from D. to zero mile. After a certain height was attained on the gauge at zero mile any rise in the river did not affect it,—the extra water spilt out above. The channel below zero mile was made capacious enough to carry the maximum amount of water that could get to it as far as an escape that was 7 miles down. This escape was then used to decrease the supply in case of local heavy rain, &c. Flood Regulators were successfully used on canals that could strike inland and were not confined, as in this example, to the necessity of the river by a "*Bhangar*."

*The Draw.*—There are other ways of increasing the draw beside the primitive one of increasing the bed slope. A branch was made from the upper canal, and as the land on its right bank was no good the bank was allowed to breach on that side and the water to spill over till a great lake was formed. The opening of the branch had a marked influence on the canal as far as the head. The escape made from zero mile was found very useful too for improving the draw.

*The Intermittent Supply.*—The drawback to their not being perennial is not so great as would appear to be the case at first sight. If they were perennial in their present unregulated state most of the ground would become waterlogged in a few years, and the country too unhealthy for habitation. If a man can give his *rabbi* lands a good soaking in August or September, he only wants to give them subsequently 2 or at the most 3 small waterings from his well to get a really good wheat crop. For this reason most of the rice lands carry a wheat crop.

E. A. S.

KOREISHI; October 28, 1888.

LOST INVENTIONS.—A paragraph is now going the rounds of the daily press to the effect that "many of Edison's most valuable inventions have been lost to the world by the avarice of that grasping monopoly, the Western Union Telegraph Company." The article states with great circumstantiality how this telegraphic leviathan has buried out of sight inventions which, if utilized, would greatly decrease the cost and increase the speed of operation, but which are, nevertheless, considered to be more profitable to suppress than to use.



## INUNDATION CANALS.

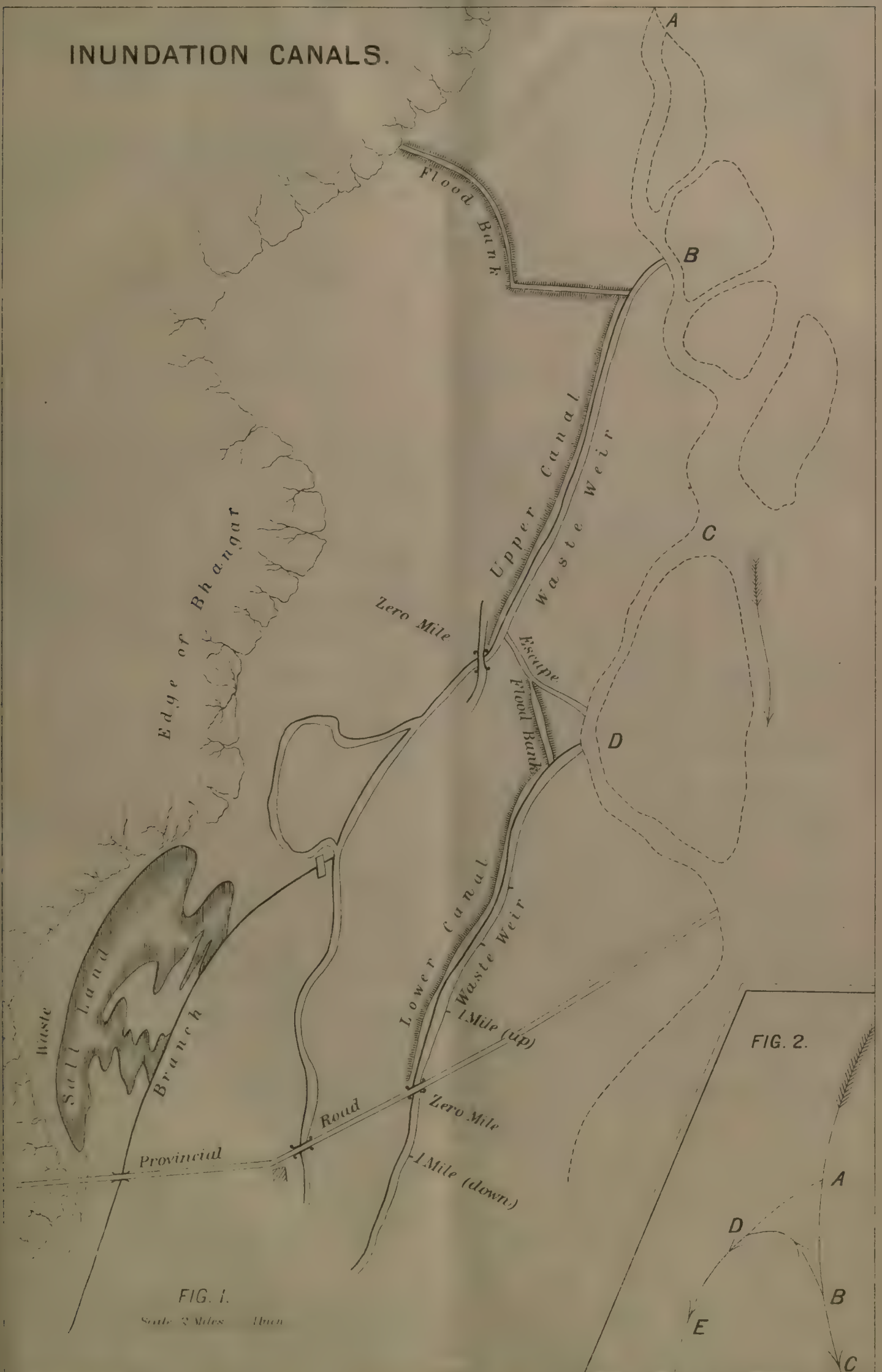
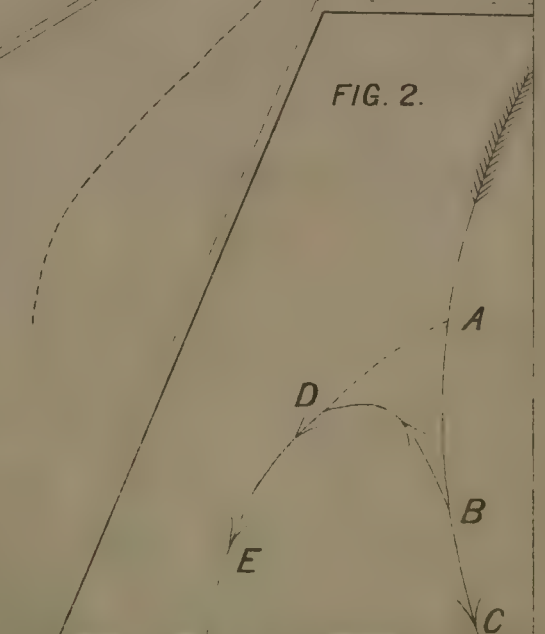


FIG. 2.







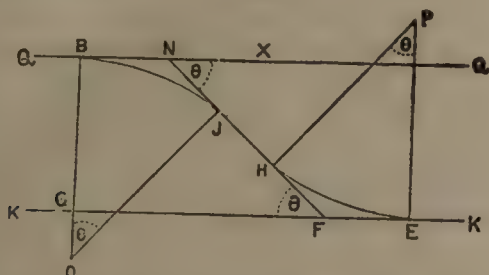


REVERSE CURVES.  
MR. CAMPBELL'S PROBLEM.

I.

WITH reference to Mr. Campbell's suggestion that his problem for parallel Railway lines should be generalised so as to take the case of two lines inclined at some given angle different from zero, it is to be noted that some modification is necessary in his enunciation of the generalised problem.

*Fig. 1.*



*Fig. 1* is practically identical with that given by Mr. Campbell. I have kept the lettering unchanged.

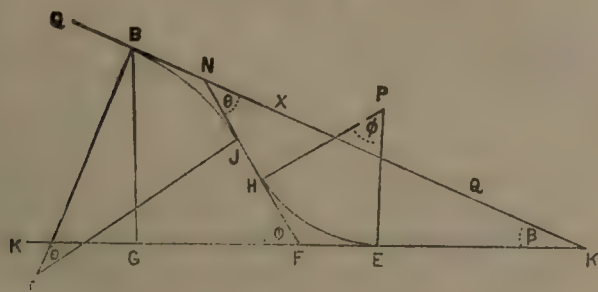
O is the centre of the circle of which BJ is a chord.  
The angle  $JNX = BOJ$ .

Similarly if P be the centre of the circle E H we have the angle  $H F G = E P H$ .

Now  $\angle N X = \angle F G$ , because the Railway lines are parallel, and the angle  $\angle B O J = \angle P H$  because we have equal arcs of equal circles. Here all Mr. Campbell's assumptions are mutually consistent.

But then he proposes that the Railway lines shall make some angle  $\alpha$  with each other, and that we shall still have  $OB = PE$  and  $BN = EF$ . See *fig. (2)*.

*Fig. 2.*



If  $OB = PE$  and  $BN = EF$  we must have the angle  $JNX = HFG$ . And then as these are what Euclid calls alternate angles, we must have the line  $KK$  parallel to  $QQ$ .

If therefore Mr. Campbell wishes to have the solution of some general problem he must either give up the equality of the two circles, or he must give up the equality of the lines  $B N$  and  $F E$ .

What I suppose he desires is to have the problem so generalised that his solved problem shall be a particular case of the general problem.

For example if he were to prescribe that  $E P$  shall equal  $O B \cos \alpha$  where  $\alpha$  is the angle between the Railway lines; then if this problem were solved it would, when  $\alpha$  becomes zero, reproduce his particular case.

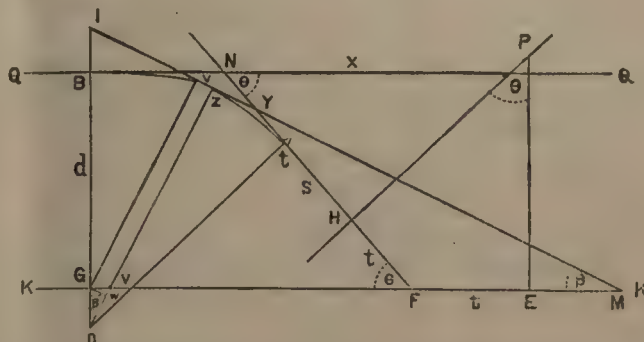
The condition  $EP = OB \cos \beta$  is only given as an illustration. The condition  $EP = OB \cos^2 \beta$  would do equally well, and in fact an unlimited number of other conditions could be devised. Each would give a different solution for the general case, but each if we put  $\beta = 0$  would reproduce the case which Mr. Campbell has solved. I think Mr. Campbell might usefully give the algebraical work for his own particular case. I have verified his investigations.

## II

It has been shewn that in Mr. Campbell's problem where there are two arcs of equal length and of equal curvature, we must either give up the equality of length or the equality of curvature if we wish to have the Railway lines

at an angle. There is no Engineering reason for having the arcs equal in length, but the curvature of arc is related to the safety of the train. I propose therefore to retain the equality of the radii. A general solution may then be made to flow from the particular case in a way I proceed to explain.

*Fig. 3.*



In *fig. 3* we have *fig. 1* reproduced with certain additions. The letters in *fig. 3* agree with those in Mr. Campbell's diagram. But for lengths I use small letters and to prevent confusion I have avoided using the capital letters R, S, T, L, D. I have reworked Mr. Campbell's formulæ and I obtain his result. I do not give the working here, as I leave Mr. Campbell to establish his formulæ (1) and (2) in his own way. I write them thus

$$l = \sqrt{s^2 + 4rd} - d^2 \quad 1$$

$$t = \frac{rd}{s+l}$$

To these I now add the formulæ for the general case which I work out in detail.

In *fig. 3* we have a point *G* arbitrarily given in a straight Railway line *K K*. *Q Q* is a parallel line at a given distance *d*. In Mr. Campbell's problem the curves *B U J* and *H E* have been constructed.

Now imagine the Railway line  $Q$  so that it begins to move rolling on the fixed curve  $BUJ$  so that the moving line always touches the fixed circle.

In this way the line  $Q Q$  changes to the line  $I U$   $Y M$  which cuts the main line  $K K$  at a *given* angle  $\rho$  and at a point  $M$  whose position depends on  $\rho$ . If  $\rho=90^\circ$  we shall have  $G M=O B=r$ . If  $\rho=0^\circ$   $M$  goes to infinity. If  $\rho$  is some small angle we shall have  $G M$  large compared with  $G B$ .

Let the rolling line touch the circle B J at the point Z. Then the angle B O Z =  $\rho$ . O Z cuts G M in V and G W is drawn parallel to I M or perpendicular to O V. We shall have given  $r$  the radius  $s$  and the piece of straight line. But the length  $d$  is no longer apparent on the ground. We shall have to construct it or to calculate it.

As the angle  $\angle OGM = 90^\circ = \angle OZM$ , it follows that a circle could be drawn through the four points  $O, G, Z, M$ . Thus  $OVZ$  and  $GV M$  are intersecting chords of this circle, and therefore

$$O V, V Z \xrightarrow{\sim} G V, V M \quad (3)$$

We could get the same result by considering the similar triangles  $OVG$  and  $VZM$ .

Now  $O B=r$  and  $G B=d$  thus

$$O \ G = r - d$$

$$O V = \overline{r - d} \sec \beta$$

$$G \cdot V = \overline{r - d} \tan \beta$$

$$V Z = r - \overline{r - d} \text{ Sec } \theta$$

Thus (3) gives us

$$\left\{ G M - \overline{r-d} \tan \beta \right\} \overline{r-d} \tan \beta$$

$$= \overline{r-d} \sec \beta \left\{ r - \overline{r-d} \sec \beta \right\}$$

$$\text{or } G M - \overline{r-d} \tan \beta = \left\{ r - \overline{r-d} \sec \beta \right\} \operatorname{Cosec} \beta$$



Thus,

$$GM = r \operatorname{Cosec} \beta - r - d \left\{ \sec \beta \operatorname{Cosec} \beta - \tan \beta \right\} \\ = r \operatorname{Cosec} \beta - r - d \sec \beta \left\{ \frac{1}{\sin \beta} - \sin \beta \right\}$$

$$\text{because } \tan \beta = \frac{\sin \beta}{\cos \beta} = \sin \beta \sec \beta$$

$$\text{Thus } GM = r \operatorname{Cosec} \beta - r - d \sec \beta \frac{1 - \sin^2 \beta}{\sin \beta} \\ = r \operatorname{Cosec} \beta - r - d \cot \beta \quad (4)$$

And  $GM = GU \operatorname{Cosec} \beta$  from the right angled triangle  $MGU$

$$\text{Thus } GU = r - r - d \frac{\cos \beta}{\operatorname{Cosec} \beta} \\ = r - r - d \cos \beta \quad (5)$$

This last equation might have been directly obtained by noticing that  $GU = WZ = OZ - OW = r - r - d \cos \beta$ .

Now  $G$  is a given point and the sloping line  $IM$  is given in position. Thus we can draw a perpendicular to  $IM$  from  $G$  and thus  $GU$  is a given or ascertainable length. Let  $UG = c$ .

Thus

$$c = r - r - d \cos \beta \\ d = r - r - c \sec \beta \quad (6)$$

When the line  $IM$  is given we can from (6) obtain the quantity  $d$ . We can then use the formulae (1) and (2) obtained by Mr. Campbell and proceed to lay out the line  $E H J Z$  as if we were constructing with the old line  $Q Q$ . Our curve  $J Z$  will run tangentially into the line  $IM$ , and the problem is therefore completed for the general case.

From the equation (6) might be constructed a geometrical method of obtaining  $GB=d$  from knowing the length  $GU=c$ . I suggest to Mr. Campbell to rewrite his note giving the working. He could then extend the problem in the way here indicated. Finally he might give some particular cases. It is to be noticed that I have tacitly assumed  $\beta$  that is a small angle. If we keep increasing  $\beta$  we shall make the point  $Z$  move down to  $J$ . Then the Railway line  $IM$  coincides with the straight piece  $JH$  and one of the circular arcs has disappeared.

A. EWBANK.

## RAILWAY WORK IN UPPER BURMA.

### I.

If your Paper is to become the Service Paper for our profession in India, we should, I think, keep each other better informed as to what work we are doing and how we carry this out, under the varying conditions of climate and labour, through its medium.

To give such contributions their proper value, and to ensure that such be not made the medium of complaints and recriminations against brother officers, they ought to be signed by the writer.

### RAILWAY WORK IN UPPER BURMA.

To begin with, I will endeavor to give a brief account of how a Railway was started and carried out in a country without maps, but recently annexed, where contracts and work (according to our ideas) were unknown. I can only deal with the portion with which I was immediately connected. In December 1886 I was sent to Mandalay to take charge of the Kyaukse Division of the Tongoo-Mandalay Railway, being the length from 10 to 40 miles south of Mandalay. I had one subordinate, no office, and no other instructions, beyond a roll of sections. I reached Kyaukse on the 23rd December, and took possession of a small deserted Phoongye-Chung, the only

shelter available. During the first month I was engaged in finding out the line, as pegged out; this was difficult as there was no map of the country, and the line ran through paddy-fields and bheels where riding was not possible. By the end of January 1887, I had got a few tools, and earthwork was started by the villagers; at first, they would only work for daily payment. By paying them daily on the work at the rate of one rupee to 3 (men or women) we soon had many thousands on the work, and they began to understand what they had to do; after about a month, with much trouble, we succeeded in getting them to do the work by contract. The staff now had joined and four Sub-Divisions were formed, and the earthwork finished about July at Rs. 7-8 per 1,000 cubic feet contract rates and Rs. 10 per 1,000, including tools, &c. For 20 miles the line ran through an irrigated country, with paddy grown all the year round. Mile by mile as the bank progressed, the irrigation channels had to be bunded up to allow the water to drain off, before we could get earth from the borrow-pits, and for about 3 miles in bheels water had to be daily baled out, before work could go on. The line had been set out in a great hurry, when the district was in a state of war, and 7 miles had to be re-aligned; the pegs were not found to have been disturbed, except where ploughed up. It was intended to lay the rails on the surface of the ground for carriage of material, but this was found to be not possible with 6 inches to 3 feet of water over the country at any time of the year; so as there were no roads in the district, the rails had to be first laid on the bank before materials could be brought to bridge sites. To do this, timber bridges over all waterways were required high enough to pass flood waters during the rains. Where possible these were placed on diversions, but in many places this was not practicable, and timber bridges had to be put in at centre of line, at formation level; the latter though giving a much easier line to run over, caused some trouble in places when building the permanent masonry bridges underneath, where the beams were upheld by sleeper stacks in the embankment. At the end spans, in such cases, the sleeper stacks were taken up, and put down to bottom foundation depth as each permanent bridge was commenced. This was done on Sundays or between running of trains, so as not to stop material trains. Where piles were used alone there was no difficulty, as they were driven well below bottom of foundations. Spans of 10, 15, 20, and 30 feet were chiefly used for these timber bridges. Piles were driven, on an average 12 feet, the soil being clay, except in the case of the larger ones, where the bed was coarse sand and gravel; in but one bridge did the slightest subsidence of piles occur (with 4 trains running daily), and this was probably due to these two rows of piles not having been driven into full depth, the staff being ill or drunk at the time. Over 2,000 running feet of these bridges were put up, and 35 miles completely bridged; some were 200 and 300 feet in length, and of considerable height. They served their purpose well; the whole of the permanent way material for 60 miles was carried over them, as well as stone, lime, sand, and bridge material for 45 miles of line. Teak was used entirely at a cost of one rupee per cubic foot, from petty local dealers and about Rs. 1-4 from the Bombay-Burmah Trading Company. My estimate was Rs. 20, 30, 40 per running foot for spans of 10, 15, and 20 to 30 feet, respectively, or Rs. 2,000 per mile, and I don't think this was exceeded, taking the value of material, available for sale when dismantled. The cost of, bringing up the timber and winches, pile-drivers and monkeys was very great, without a service road alongside the line. There was much delay from this cause also, which made it very difficult to keep bridging in advance of the platelaying. The rate for dressing and fixing in position complete was Rs 1-4-0 per cubic foot, and for driving piles annas 6 per running foot. This work was done by Chinamen mostly; the rate was high, partly on account of the workmen having to live at bridge-sites without protection, to the climate being bad, and the work scattered (two Chinamen were



killed, and many died of fever and dysentery). This work was done within 6 months. An attempt was made in August to carry plant and material to the Panglong River, a large stream, at the south end of the Division, by working up in a steam launch, from the mouth of this river, near its junction, with the Irrawaddy. Unfortunately the rains were light, and the river fell at the time, and after grounding several times, I had to turn back. The steamer drew  $2\frac{1}{2}$  feet of water; country boats could easily have carried up all we wanted, but the whole stream on both sides being in the hands of dacoits, no boat would venture up, and in open boats any guards sent with them, would have been shot down from the banks lined with jungle on both sides. The launch was defended with gunny bags filled with sawdust piled round the poop and lower deck. Several parties of troops were about, and heard our whistling as we rounded corners with much surprise, and we heard afterwards that the dacoits were still more astonished at a steamer for the first time coming into their fastnesses. On returning, the steamer got aground, with a large log of teak across underneath. We could not get to the bank, and were without wood to cook with. Got off next morning, much to the satisfaction of the serang in charge, who thought he was going to leave himself and boat in the jungle for good. It was very annoying, and a great disappointment to me, this failure; as I did not get this plant up to the bridge until after the rains, three months afterwards. Platelaying; Ballasting; Permanent Bridging will next be described.

T. E. OWEN

November 15.

(To be continued.)

## NOTES FROM HOME.

(From our own Correspondent.)

VERY satisfactory progress is being made in the construction of the Railway Bridge over the Dee. The completion of this bridge will put the Welsh Coal-fields in direct communication with Birkenhead, and the construction of the authorized lines of the Wirral Railways will open up communication with Liverpool *via* the Mersey Railway.

The death is announced of Mr. John Fowler, the Chief Engineer of the Tees Conservancy Commission, in his 64th year. He was for seven years assistant to Mr. Johnston who was Engineer to the Tees Navigation Company and on the death of that gentleman, in 1854, became Engineer to the Tees Conservancy Commission, which was formed in 1852. The improvements in the Tees estuary, transforming it from a shallow stream into a navigable river, have either been conceived by Mr. Fowler or carried out under his supervision. Mr. Fowler was also Consulting Engineer to the Ouse Navigation Company.

The Midland Railway are now carrying out a very important extension of their system at Ripley, which will be the means of linking a rich mineral district to two of the principal arteries through which the Railway traffic of the country passes. Technically, the new line is in two parts. The first section commences on the south side of Ripley Station taking a northerly direction, curving round Lowes Hill and joins the Midland at Butterley Station. The second portion takes an easterly direction from the existing Ripley branch and joins the Erewash Valley main line between the Langley Mill and Shipley Gate Stations. The Railway has been a difficult one to construct. At a place called Hammersmith is a viaduct of 12 spans which, at its greatest elevation, is 70 feet above the water-level. Near the viaduct is a double-storeyed bridge—a cart road runs through the embankment at its base, and through the next storey there is carried a line of rails belonging to the Butterley Company. The old line, which terminates at Ripley Station, will in future be used only for mineral traffic. It is confidently expected that early in the new year this very important development of the great network of our Railways will be opened for business.

Already threatened with an advance in the price of coal due to the strike in the coal districts, the public look with justifiable anxiety on a large combination of capitalists and

coal owners in the form of a proposed "Collieries Trust," the professed object of which is, not to enhance the price of coal, but on the contrary by some "special system now in contemplation" to produce results which will be most advantageous for the coal consumer.

The figures that are used to justify the formation of this Trust shew the enormous character of the interests at stake. It is stated that 160 millions of tons of coal are annually raised in this country at a cost of some 35 to 40 millions annually, of which three-quarters is paid in wages, and that the annual profits do not exceed 2 per cent. upon the enormous capital employed. It will be interesting to the great consumers of coal, such as the Railway Companies, Steamboat Owners, Gas Companies and all descriptions of manufacture dependent on the use of steam power, to know what the proposed "Trust has in contemplation" to alter the present state of things without enhancing the price of coal.

At a meeting of the Metropolitan Board of Works held a short time since it was decided to build a second sludge ship, and the tender of the Naval Construction and Armaments Company amounting to £24,784 for the construction of the ship was accepted.

It will be remembered that the first sludge ship was designed and constructed by the Barrow Ship Building Company and was launched from the Company's yard at Barrow in Furness in May last. Her cost was £16,952 10s.

The fleet of Atlantic Liners has just been added to by the launch of the *City of Paris*, a sister ship to the *City of New York*, the largest ship in the world, and whose speed will, it is expected, be excelled by the more modern of these magnificent specimens of Atlantic passenger ships.

Two sleeping cars have just been built by the Pullman Palace Car Company to run on the New York and New England Railway. Among the new features is the arrangement of the water system. Valves in connection with the Westinghouse Air Brake reservoir enable the water stored in tanks under the car to be forced through the piping by the air pressure, thus doing away with pumps and tanks inside the car. The car is extra large, having 14 sections, a smoking-room and a drawing-room. The toilet rooms are increased in size and more conveniently arranged.

The stage of the Parc Theatre, Brussels, has recently been lighted by means of the Wenham Safety Gas-lamp, and it is understood that the experiment is a complete success. This light being entirely enclosed, avoids the danger that accompanies the use of naked lights on the stage. These lamps have also been used with success at Covent Garden Theatre.

## The Gazettes.

## PUBLIC WORKS DEPARTMENT.

## Burma, November 10, 1888.

Mr. P. E. Raven, Assistant Engineer, 1st grade, Rangoon Division, reported his return to duty on the forenoon of the 29th October 1888 from the language leave granted him in *Burma Gazette* Notification, dated the 29th August 1888.

## Madras, November 13, 1888.

The following posting is ordered:—

Mr. J. H. Toogood, Executive Engineer, 2nd grade, sub. *pro tem.*, Bengal, to the charge of No. III. Party, Tank Restoration Scheme, Kurnool.

## Bombay, November 15, 1888.

Captain H. D. Olivier, R.E., having returned from furlough, should resume charge of the office of Executive Engineer, Bombay Military Works.

Mr. C. N. Clifton, on being relieved, should revert to Executive Engineer, Kaira.

Mr. G. C. Beresford, Assistant Engineer, 2nd grade, is allowed furlough to Europe on medical certificate for one year, with the usual subsidiary leave, under the rules in the Civil Leave Code.

## Punjab, November 15, 1888.

Mr. A. Grant, Executive Engineer, Kohat Division, is granted two years' furlough.

Mr. F. W. Maunsell, reverted from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, with effect from the afternoon of the 29th September 1888, *vice* Mr. Jeffery returned from furlough.

## Irrigation Branch.

Mr. S. Preston, Executive Engineer, 2nd grade, from the Ludhiana Division, Si-hind Canal, which he left on the forenoon of the 6th October 1888, to the Swat River Canal Division, which he joined on the forenoon of the 15th idem. Mr. Preston took



over executive charge of the Swat River Canal Division from Mr. Sadler, Executive Engineer, on the afternoon of the 16th October 1888.

Mr. B. Douglass, Assistant Engineer, 1st grade, Delhi Division, Western Jumna Canal, passed the Departmental Standard on the 21st October 1888.

Mr. R. Sadler, Executive Engineer, 2nd grade, from the Swat River Canal Division, which he left on the afternoon of the 16th October 1888, to the Ludhiana Division, Sirhind Canal, which he joined on the forenoon of the 23rd October 1888.

With reference to Irrigation Branch Notification, dated 16th August 1888, Mr. H. F. Smallman, Executive Engineer, 2nd grade, returned from three months' privilege leave on the forenoon of the 27th October 1888, and took over executive charge of the Upper Sutlej Division, Inundation Canals, from Rai Bahadur Ram Dyal, Executive Engineer, on the forenoon of the same date.

#### N.-W. Provinces and Oudh, November 17, 1888.

##### Irrigation Branch.

With reference to Government of India, Public Works Department, Notification, dated 12th October 1888, posting him to these Provinces, Mr. W. R. Williams, Assistant Engineer, 2nd grade, is posted to the Nadrai Aqueduct Division, Lower Ganges Canal.

With reference to Government of India, Public Works Department, Notification, dated 12th October 1888, posting him to these Provinces, Mr. A. B. Gale, Assistant Engineer, 2nd grade, is posted to the Eastern Jumna Canal.

Mr. N. F. McLeod, Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India four days' furlough in extension of that granted him in Notification, dated 25th October 1888.

The appointment of Mr. J. A. Cones, Temporary Executive Engineer, 4th grade, to the charge of the Anupshahr Division, Ganges Canal, notified in G. O., dated 15th September 1888, is cancelled.

Mr. F. Reilly, Assistant Engineer, 2nd grade, Nadrai Aqueduct Division, Lower Ganges Canal, passed the Departmental Examination, on the 16th October 1888.

His Honor the Lieutenant-Governor, North-Western Provinces and Chief Commissioner, Oudh, is pleased to order the following promotion, with effect from the date specified:—

Mr. F. Reilly, from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, sub. *pro tem.*, to fill a vacancy, with effect from 16th October 1888.

Mr. A. C. Evans, Executive Engineer, 4th grade, is transferred from the 2nd to the 1st Circle, Irrigation Works, and posted to the charge of the Aligarh Division, Ganges Canal, during the absence on deputation of Mr. R. A. Cordner, Executive Engineer, 1st grade, or until further orders.

Mr. A. L. Webb, Assistant Engineer, 1st grade, is transferred from the 1st to the 2nd Circle, Irrigation Works, and posted to the Nadrai Aqueduct Division, Lower Ganges Canal.

##### Buildings and Roads Branch.

Ghulam Nabi, Supervisor, 2nd grade, held charge of the Bijnor District from the afternoon of the 14th September up to the forenoon of the 6th October 1888, during the absence of Mr. E. A. Phillips, District Engineer, on privilege leave.

#### Central Provinces, November 17, 1888.

With reference to Public Works Department Notification, dated the 25th October 1888, Mr. D. Wallace, Executive Engineer, took over charge of the Jubbulpore Division from Mr. H. L. Cleaver, Assistant Engineer, on the forenoon of the 2nd instant.

With reference to Notification, dated the 7th August 1888, Mr. G. M. Harriott, Executive Engineer, returned from the privilege leave granted him, and joined his duties in the Kanhan Division on the afternoon of the 27th October 1888. The balance of Mr. Harriott's leave, viz., 2 days, is hereby cancelled.

#### Assam, November 17, 1888.

Rai Preonath Banerji, Bahadur, Executive Engineer, 3rd grade, who was posted in Public Works Department Notification, dated the 16th July 1888, to the charge of the Cachar Division, reported his arrival at Silchar on the forenoon of the 10th November 1888, and took over charge of the Cachar Division from Rao Sahib Matadin Sukul, M.A., Assistant Engineer, on the afternoon of the same day.

#### Bengal, November 21, 1888.

Mr. T. Butler, Assistant Engineer, has been granted by Her Majesty's Secretary of State for India an extension of three months' furlough.

## Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act V. of 1888, in the Office of the Secretary to the Government of India in the Revenue and Agricultural Department:—

#### The 5th November 1888.

212 of '88.—William Jackson, of Aberdeen, North Britain, Engineer. Amended specification of his invention.—For improvements in apparatus for drying tea leaves.

12 of '88.—John Phelps, proprietor of the Firm of Phelps & Co., of Calcutta, Simla and Lahore.—For an "Eavesgutter" for collecting and discharging drainage from the roofs of buildings.

48 of '88.—George Anderson, M. Inst. C. E., of Madras, in the Empire of India, Civil Engineer.—For improvements in plant for laying permanent-way.

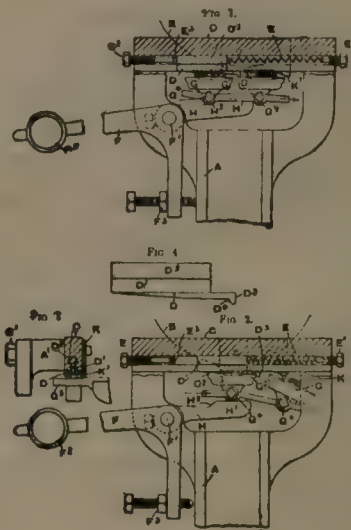
58 of '88.—Bernard Conrad Schumacher, of 127, Fenchurch Street, in the City of London, but at present residing in Calcutta, Manager of the Pegu Rice Company.—For an improved method of husking, winnowing, and cleaning rice and other grain, seeds, and berries, and apparatus therefor.

64 of '88.—John Brown Evans, of Mabus, Cape of Good Hope, South Africa, but temporarily of London, England, Farmer.—For improvements in wire-fencing.

68 of '88.—The Farbenfabriken vormals Friedrich Bayer and Company, of Elberfeld, in the Empire of Germany, Dye and Colour Manufacturers.—For improvements in the manufacture of azo dyes.

#### RECENT BRITISH PATENTS.

GRINDING THE FLATS OF CARDING ENGINES.—J. W. MacConnel and J. Higginson, Manchester.—This invention relates to Clegg and Lucas' apparatus (Patent No. 623 of 1874) for grinding the flats of revolving carding engines while the flats are supported by their working surfaces upon a wedge sliding on guide under the grinding roller. The improvements consist in compelling the flats to release the wedge as soon as the wires have been ground. Fig. 1 shows a side view, with the flats in their ordinary position; Fig. 2 shows a view with one of the flats being ground; Fig. 3 is a cross section through the guide and slide, and Fig. 4 is an enlarged side view of the wedge. The apparatus is attached to the bracket A, which supports the grinding roller B. The guide C is made hollow with a narrow slit at the bottom, through which the web D<sup>1</sup> passes. The web D<sup>1</sup> connects the wedge D and the slide D<sup>2</sup>. A spring E is inserted in the tube, which is closed by the screw E<sup>1</sup>; the spring presses the slide and wedge to the left against an adjustable stop E<sup>2</sup>. A lever H is arranged below the guide, and is fixed upon a short shaft F<sup>1</sup>, which oscillates in the bracket A; the lever is held in position as in Fig. 1 by the weight F<sup>2</sup>. Below the guide C the lever H has a face H<sup>1</sup> of about the same width



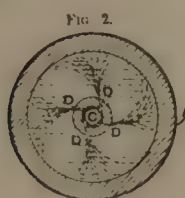
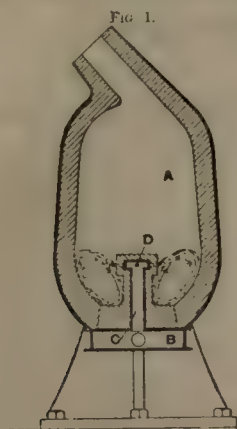
as the card fillet centrally below the grinding roller, and a short incline H<sup>2</sup> in front of it. As the two flats G G travel along, the lug G<sup>4</sup> comes against the incline H<sup>2</sup>, and is lifted up and the flat is pressed against the wedge D by the lever. The corner G<sup>1</sup> of the flats seizes the projection D<sup>3</sup> of the wedge, and carries it along under the grinding roller, as shown in Fig. 2. When the lug G<sup>4</sup> has passed the face H<sup>1</sup>, the wedge is liberated. This is effected by the projection which is seized by the flat being inclined to the guide, as at D<sup>4</sup>, and by the part of the flats which seizes the projection being of corresponding shape. Means are also supplied for forcing the flat away from the wedges as soon as the lug on its back has reached the end of the lever H. For this purpose, a plate K is attached to the inside of the guide C, and it has an inclined projection K<sup>1</sup>, against which the flat comes as soon as the lug on its back has passed over the face H<sup>1</sup>, and which forces it down and causes it to release the wedge D. Four claims are made for the tubular guides; for the inclined projections on the wedge, and part of the flat coming against it; for forcing the flat away from the wedge after grinding the wire; and for the plate K and incline K<sup>1</sup>.—No. 6599. May 3rd, 1888.

#### RECENT AMERICAN PATENTS.

CONVERTERS.—J. W. Bookwalter, Springfield, Ohio, U. S. A.—The object of this invention is to obtain the completest circulation of the molten metal in the Bessemer converter, while at the same time avoiding the production of such currents as will cause the scoria to be drawn into the metal. The converter is constructed in the usual manner, and is provided at the bottom with an air chamber B, through which the blast is conducted to the tuyeres. In the centre there is



a vertical shaft C, which is composed or surrounded by fire clay; the top of it is closed, and a series of lateral openings D allow the air to reach the iron. These openings give a horizontal direction to the air blast, and the issuing jet imparts a horizontal rotary motion to the molten



metal. The motion of the air towards the outer circumference of the mass of metal will also give the upper portion of the metal a motion from the centre of the mass radially outwards, and will consequently cause the iron to rotate in a vertical plane. As the air acts near the surface, and does not penetrate into the body of the metal, the impurities remain on the surface near the walls of the converter. In order to keep the blast at the same distance from the surface while the metal sinks, the shaft C may be made telescopic. Three claims are made—No. 6952. May 9th, 1888.

## ADVERTISEMENTS.

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### IMPORTANT NOTICE.

All Civil Engineers of the Department are informed, that, owing to the extended support accorded to the Civil Engineers' Association, the Committee feel it necessary to still further widen their sphere of influence, and to delegate some of their duties.

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Every Civil Engineer is urged to write to the Hon. Sec. c/o Grindlay, Groom and Co., Bombay, who will put him in touch with his Sub-committee, with the view of enrolling him a member of the **Civil Engineers' Association.**

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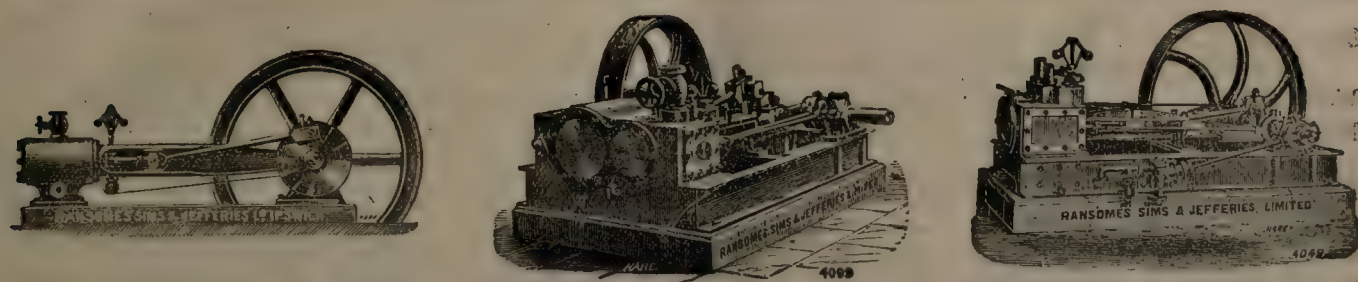
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# INDIAN ENGINEERING.

SATURDAY, DECEMBER 1, 1888.

## THE BOMBAY P. W. D.

A PROMINENT feature of a bureaucratic Government, is the time-honored institution of shifting the bugbear of responsibility from one shoulder to another, till the public is lost in a maze of doubt and difficulty as to who is the right party to be saddled with the failure of a scheme. The ball is kept rolling to the infinite delight of the players but to the bewilderment of lookers-on. Even when a victory is scored it fails to do honor to the right or deserving party, everything is so beautifully entangled in the cobweb of official verbiage. To quote an instance in point, the Resolution of the Government of Bombay on the re-organisation of the Public Works Department speaks for itself. As a rule, some vague apology is brought forward in extenuation of the measure, in order to be prepared for any contingency by way of adverse criticism. But if all that is said in the Resolution were *facts* very little could be said against them. Unfortunately, however, the opposite is the case. There are a good many assumptions. It (the Resolution) tells us that the re-organization which is now trumpeted forth to the world, dates back to the time of Sir Bartle Frere—the conclusion being, that his immediate successors were not alive to its importance, or they would have carried it out to a satisfactory conclusion. On the contrary, we are informed by an authority, that when the late Sir Bartle Frere was Governor, there was a Chief Engineer, and the Secretary to the Public Works Department was a Civilian; but the present scheme is altogether a new one. The former, however, shewed no good results. The two officers being separated was a fruitful cause of friction and divided responsibility. The best thing that could be done under the circumstances was to assimilate them, and an Engineer Officer was appointed Secretary and Chief Engineer. A change, however, came over the spirit of our ruler's dreams. Generals Kennedy and Goodfellow did their duty well and to the satisfaction of the public, and when the latter retired, bureaucratic Government again scored a victory. It was nevertheless done in a spirit of humiliation. After being baffled in all attempts to hoodwink the Government of India, but without success, the Bombay Government hit upon the expediency of begging the Secretary of State to grant the indulgence upon which it had set its heart, and rather than be troubled with importunities, the Secretary of State acceded to the request, more with the object of evading the point at issue, than of doing justice to all parties concerned, and what is now announced was practically in force eighteen months ago. The object of this new fangled scheme is to separate the Secretaryship from the Chief Engineership, so "that the Chief Engineers and professional advisers of Government shall be relieved, as far as possible, of purely administrative (non-professional)



duties and keep it in direct touch with the Engineering operations of the divisions to which they severally belong." A little further on we are told that of four officers in charge of divisions, two will be graded as Chief Engineers and two as Superintending Engineers—each will be in an independent professional charge of his division, and exercise the powers of a Chief Engineer as laid down in the Public Works Code. By a certain process of metamorphosis "the two Superintending will exercise in their own divisions, the powers of a Chief Engineer, and the Chief Engineers will perform the duties of Superintending as well as Chief Engineers." Herein lies the difference between "Tweedledum and Tweedledee." So far so good on paper, but in practice it may be accompanied with a trifling inconvenience. Be it observed that there is an intermediary Secretary through whom communications must pass to the Government of India, or rather, the member in charge of the Public Works Department. He may be a junior member of the service or may not belong to the profession at all. Then? Why, there is balm in Gilead for those who stand in need of it. The Resolution provides that "in all matters of professional detail the Chief and Superintending Engineers will be the advisers of Government for matters within their respective divisions, and their advice and opinion on such matters will not be liable to be criticised or overruled by the Departmental Secretary, who will ordinarily be their junior." But suppose the latter was tempted to override the orders of Government, what then? There is no penalty attached to this breach of discipline. Whatever precautions may be taken to obviate this difficulty it is to be feared they will be in vain. The Secretary to Government in any department enjoys a position peculiarly his own and to hedge it round with restrictions is a moral impossibility which we, living under a bureaucratic Government, know to our cost. A Bombay paper pertinently points out:—The appointment is to be conferred on the present Under-Secretary, who during his eighteen years' service has spent only one year in district or administrative work. In this case the appointment will be made, not with special reference to administrative qualifications, but with special reference to clerical qualifications. The Under-Secretary will supersede all the Executive Engineers in the first grade, and thus, an injury and injustice will be done to a large number of men who have spent their lives in doing the rough work of the Department. Thus after eighteen months the problem has been solved. Who is to be Secretary to Government in the Public Works Department? And it is open to grave doubt whether it was worth while to create grave discontent throughout a whole department to make the change. But the Secretaryship is not to be an undivided sinecure. There is to be a Joint-Secretary, who "shall be experienced in questions of irrigation and administration." How long these qualifications are to be upheld as a *sine quâ non* for the post yet remains to be seen. It will be the old saying of these posts being a close reserve for 'Somebody's Somebody' or 'My Friend's Friend.'

## SELECTION IN THE P. W. D.

WITH reference to Government of India No. 2048G., dated 14th October 1887, which forms the subject of a round of jubilant applause from an independent (sic) contemporary, there can be no doubt that the idea at the root of the circular is a good one. Commercial firms and private employers are generally credited with commonsense and a particularly acute perception of their own interests, and none would for a moment think of increasing the salaries of all employes on the grounds of mere length of service and freedom from gross fault. Now without pressing the analogy further than it will bear, and Government service in many respects differs radically from private employ, it is clear that some method of selection is especially needed in the present state of blocked promotion alike in the interests of Government and of the best men in the P. W. D. But the present circular is only a halfway halting place between the present deadening system and a fair and aboveboard selection from the day that a man enters the service till he leaves it. The resolution runs:—

"On the 1st of June next.....recommendations should be carefully prepared in full and without reference to any previous reports.....concerning all Executive Engineers in the first grade whom the Local Government considers fit for promotion.....Each Local Government will also furnish a list of the men in the first grade.....whom it considers unfit." Now on very slight consideration it will be seen that the "Local Government" means the Chief Engineer or rather the Superintending Engineers who report to him. The Local Government has no means of checking the reports it receives and must assume their *bond fides*.

Without for one moment casting the slightest doubt on the impartiality of the reporting officer, it is clear that a system of selection should leave as little as possible to the personal element, which consciously or unconsciously must always play a most important part, and should aim at eliminating this factor as far as possible.

Such a system is by no means difficult to devise. If instead of opinions, which may or may not be sound and fair ones, a regular register of the actual work done by an officer from the day he entered the service were kept in half-yearly or yearly periods, and bound up as his personal ledger the promoting authority would have something tangible to go on.

These reports should contain the officer's name, class and standing, the work engaged on since his last report, its cost, nature and magnitude, the amount of assistance he enjoyed, the difficulties encountered, his administrative ability, the state of his accounts with reference to his estimates, the merit of his designs and other details which will readily suggest themselves, the whole being cast in a form admitting of replies based on actual facts which should be brought forward incontrovertibly and a copy furnished to the officer concerned. The would be professional organ can see only one improvement on the Government Resolution—"that each man should be told of what has befallen him." We venture to believe that our suggestions would constitute a much further reaching measure



of improvement which would also have two very great additional advantages :

- (I.) That from the earliest grades the promotion of the best men would be quickened.
- (II.) That much more personal responsibility and less routine might be allowed to the men who prove themselves worthy of trust.

#### GEOLOGICAL SURVEY OF INDIA IN BURMA.

MR. T. W. HUGHES HUGHES has left here for Rangoon by the last mail steamer, *en route* to Perak, where it appears he has, in conjunction with a Revenue official from Burma, to study the tin working by Chinese labor, with a view to the adoption of similar labor in the development of the tin resources of Tenasserim. We are glad to see that Mr. Hughes has been deputed to this work; his experience and decidedly practical knowledge of the mining branch of geological inquiry being well known: and, from what has been published in the local papers of Dr. Noetling's researches in Upper Burma, it is evident that the Government of India is anxious to utilize the services of the Geological Department in the newly acquired Province. This is as it should be, for it has been manifest to all who thought about the subject, that the sending out of Mr. Barrington Browne—the so-called expert in rubies—by the Secretary of State, on a special trip to the Ruby Mines, has been barren of any practical results; while from what we learn of the work of the Director of the Geological Survey himself in the Madras gem districts, and his visits to Ceylon, let alone the facts of his having associated with him so accomplished a mineralogist as Mr. Mallet, it is clear that the geological and economic bearings of the Ruby Mines question could have been thoroughly investigated by the Survey long ago. Dr. Noetling's report on the ruby-bearing limestone and graphites in the Mandalay District shew at once the eager grasp with which the subject can be taken up by the Department; and it is to be devoutly hoped that Mr. Hughes or Dr. Noetling may not be kept from giving us a clear view of a subject which, notwithstanding the Secretary of State's interference, still lies dormant, the glint of the subject of the precious gem being only allowed to sparkle at intervals in the mysterious announcements that the "Ruby Mines concession has been granted" or that "no treaty has been entered into with any company of concessionaires."

Dr. Noetling's other reports on the magnetic iron-ore of Singaung in the Shan Hills, and on the supposed platinum, near Mine Kine in the same hills, are likewise of great interest and importance. The latter, particularly so, though we regret to note the doubt in Dr. Noetling's mind as to the metal being actually platinum. Surely, the fragment of ore should have been sent up to the Survey mineralogist for final determination? The magnetic iron hill is, so far, a thing to be wondered at in Burma perhaps; but we know of what may be called mountains of iron in the Salem and Kurnool districts of the Madras Presidency, which, if we mistake not, were described in the *Annals of the Survey* some 15 years back.

#### Notes and Comments.

**COLLIERY TUBS.**—The East Indian Railway is calling for tenders, at home, for the supply of colliery tubs, as if such could not be made in this country.

**OOTACAMUND LAKE.**—An estimate amounting to Rs. 26,150 for fencing and improving the margin of the Ootacamund Lake has been sanctioned by the Madras Government.

**TRAFFIC MANAGER, MADRAS RAILWAY.**—The Government of India have sanctioned a maximum salary of Rs. 1,364 to Mr. L. S. Moss, the Traffic Manager of the Madras Railway.

**BENGAL-NAGPUR RAILWAY.**—The Board of Directors of the Bengal-Nagpur Railway Company, Limited, are prepared to receive tenders for 216,000 transverse steel sleepers, 475,200 steel keys for same.

**THE RUBY MINES.**—The Government have invited tenders for working the Burma Ruby Mines. Six have been received, the highest being twelve lakhs annually. The decision was to have been given ere this.

**MR. FRANKLIN PRESTAGE.**—Rumour has it that Mr. Prestage has made up his mind to retire shortly on his well-earned reputation and fortune, to spend the remainder of his days at peace and at rest in the old country.

**OBITUARY.**—Mr. Wilson Bell, Chief Engineer and Acting Agent of the G. I. P. Railway, died on the morning of the 27th November at Lanowli, and was buried at Igatpuri. He came out to India in 1864. His age was 49 years.

**BENGAL AND NORTH-WESTERN RAILWAY.**—The Directors of the Bengal and North-Western Railway Company, Limited, state that the accounts for the half-year ended 30th June admit of a dividend of 2 per cent., free of income-tax, Indian and English.

**BENGAL COAL FOR LOCOMOTIVES IN BURMA.**—We regret to learn that this experiment has failed and has caused vexatious delay to passengers by mail trains, but we believe the Irrawaddy Flotilla Company use this coal in their steamers, and no complaints have been heard regarding it.

**A GOOD SELECTION.**—Mr. C. T. Burke, B.E., M. Inst. C.E., is nominated to serve as a temporary member of the Committee for the Reduction of Account work in offices of Executive Engineers of the Buildings and Roads and Irrigation Branches of the Public Works Department, when it visits Bombay.

**KISTNA DELTA WORKS.**—The Government of India has been asked to extend the Secretary of State's sanction to the Kistna Delta Completion Estimates for a further period of five years. The amount of the sanctioned Estimate is Rs. 1,49,00,944, and the expenditure up to date amounts to Rs. 83,44,621.

**THE PRESENT STATE OF THE INDIAN P. W. D. AND ITS PAST HISTORY.**—We would particularly invite the attention of those of our readers interested in the subject to remarks of our correspondent "Veritas" in his fifth letter, which appears in this issue on P. W. D. Re-organization, which affords a wide field for discussion.

**THE MADRAS PIER.**—An estimate amounting to Rs. 36,263 for repairs and improvements to the Madras Pier has been sanctioned by Government. The work is to be carried out under the superintendence of the Harbour Trust Engineer, Mr. A. L. Pogson. Two steam cranes are shortly expected for the pier from England.



**REDUCTION IN P. W. D.**—Referring to the rumour about the proposed reduction in the Provincial Branch of the Public Works Department in Bengal, a correspondent states that if it is carried out there would be left only 4 divisions—two in Calcutta, one at Darjeeling and one at Chutia-Nagpur, under one Superintending Engineer.

**KIDDERPORE DOCKS, CALCUTTA.**—We learn that the total expenditure on this undertaking up to the date of the last quarterly inspection on the 30th September 1888 was Rs. 1,08,00,000, nearly a fourth of which amount was absorbed by the acquisition of land. The balance expenditure includes the cost of construction and of machinery and plant to date.

**NEW RAILWAY STATION, RANGOON.**—We learn that the present central station of the Burma State Railway is now quite unsuited for the traffic, consequent on the extension to Mandalay, and that a new station will have to be built at a cost of about Rs. 31,500. The opening of the line for traffic to Mandalay has been unavoidably deferred till 15th February 1889.

**MR. R. T. MALLET.**—This gentleman, as Consulting Engineer for Railways, Jubbulpore, visited the Asansol end of the Bengal-Nagpur Railway on Sunday last, arriving in Calcutta the following day. Mr. Mallet is a brother of the well-known mineralogist of the Indian Geological Survey. It is whispered that he contemplates retirement at an early date.

**E. B. S. R. ENGINEERING STAFF.**—Mr. Nicholson has returned and resumed charge of Way and Works, relieving Mr. Anderson, who will continue on the line in an executive capacity. We find that Mr. Smith goes to Madras and Mr. Greenlees goes home. These are both Executive Engineers. Mr. Pope, an Assistant Engineer, has been posted to the line.

**HOW THE MONEY GOES!**—The Director-General of Stores for India is prepared to receive tenders from such persons as may be willing to supply under-frames for carriages and waggons, trolley iron-work, crossings and switches, signals, tanks, wrought-iron. Can there be any hope for the development of Indian production when such paltry requirements are obtained from Home?

**THE PROPOSED FRONTIER MILITARY ROAD.**—Mr. Ramsay has submitted the plans, report, and estimates for a military road from Kalabagh, *via* Shikardara, to Lachu, a place on the Kohat-Bannu frontier road. This will be some 45 miles long over a very difficult country very sparsely populated. Drinking-water is very scarce, most of the nalas and springs having salt water in them.

**AUSTRIAN RAILS FOR JAPAN.**—A new Railway is projected in Japan, and I am informed that the rails and other iron-work are to be procured from Austria, negotiations having been conducted at Yokohama with the Austro-Hungarian Lloyds. This company will probably ship the material direct, and bring rice as return cargoes. The Railway will be 125 miles in length.

**CALCUTTA MUNICIPAL SANITATION.**—It is shewn that during the last 12 years the drainage scheme has been completed, the filtered and unfiltered water-supply doubled, and the roads much increased in length and better lighted and watered. Tanks have been filled up, bathing platforms constructed, bustees cleansed, and the value of land has been doubled without any increase on account of debt.

**TIRHOOT STATE RAILWAY.**—We have by the merest

chance learned that there was a Railway accident at Motiharee on the 23rd November, in which four coolies were killed: a goods train was run into a shed, in which these men were standing. Who was to blame? It has been suggested to us in this connection that publicity relative to such occurrences on this line is sedulously suppressed.

**PROGRESS OF THE C. E. ASSOCIATION IN BENGAL.**—With reference to our recent remarks which appeared under the heading "Civil Engineers—Roll up!" we are glad to congratulate this province upon the splendid progress already made—95 per cent. of its officers being now members of the above Association. It seems as though the small minority only want to know this to bring the figure to par.

**THE PROPOSED RAILWAY TO BANNU.**—As the Bannu Railway Surveys are now completed, and the plans, report, and estimates have been forwarded to Government, Mr. Ramsay is now leaving to take up his appointment as Engineer-in-Chief of the Western Bengal Railway Surveys. He has for the last month been directing the operations of the staff on that Railway while completing Bannu Railway Surveys.

**SOUTHERN MAHRATTA RAILWAY.**—We learn that the opening of the section of this line from Gubbi to Harihar, which was expected to take place next month, has been postponed for a few weeks, or till January. Some of the bridges are said to be incomplete, and this will cause delay or postponement. The tenders for altering and improving parts of the Bangalore-Gubbi Section have been forwarded to Dharwar, for decision and selection.

**THE PERIYAR PROJECT.**—The progress on these works in September has been very small owing to the difficulty in obtaining coolies, and the difficulty and cost of carriage of materials. Attacks by wild elephants on the store-sheds have frightened the coolies so much that about a hundred of them deserted in one night. The elephants appear to have a great weakness for barrels of Portland cement, which they toss and roll about till nought remains of the barrels.

**CHERRAPOONJI HILL RAILWAY.**—Sir Guilford Molesworth, K.C.S.I., arrived in Calcutta last week and has now gone to inspect the Cherrapoonji Hill Railway in Assam. One result of his inspection will be to decide finally whether more money is to be expended on remodelling it, or whether the project is to be altogether abandoned. As the later estimates of probable traffic shew that it could never be expected to pay its working expenses the latter is the most probable.

**MR. F. W. STEVENS.**—The well-known architect of the G. I. P. Railway Terminus in Bombay and the stately Sailors' Home in the same city, is devoting his well-earned holiday in England to preparing the plans for the new Hotel de Ville in the capital of Western India. Some of Mr. Stevens' English friends are anxious that he should become a candidate for the post of principal architect to the new London County Council. They think that he would have a good chance of being selected.

**WANTED—AN INDUS FLOTILLA.**—The Lahore paper dwells on the danger into which we are falling by neglect of the navigation of the Lower Indus. Properly utilised the Indus might be made a valuable internal line of defence, which ought not to be neglected. It says that what we ought to have most certainly on the Indus are gunboats below, and armoured river boats above, with a regular service of pilots who would know each



bend and rock and rapid, from the Black Mountain to the sea.

**MR. R. F. CHISHOLM ON TECHNICAL EDUCATION.**—“Notes on Technical Education addressed to His Highness Sir Syaje Rao, K.C.S.I., Gaekwar of Baroda by Robert Fellows Chisholm, F.R.I.B.A., Consulting Architect to H. H. the Gaekwar of Baroda, Fellow of the University of Madras, late Consulting Architect to the Government of Madras, late Superintendent, Madras School of Industrial Arts”, is the title of a *brochure* which we have received, and hope to notice in an early issue.

**THE WATER-SUPPLY OF MADRAS.**—The Government of India have objected to the accumulations of the sinking fund being utilized for the carrying out of the scheme for an improved system of water-supply to the town of Madras, as they consider such a proceeding wrong in principle, but have accorded their sanction to the levy of a tax on tobacco up to a maximum of  $1\frac{1}{2}$  annas a pound, and have directed the Madras Government to proceed with the legislation necessary for bringing the tax into force.

**LADY DUFFERIN HOSPITAL, CALCUTTA.**—Arrangements are now being made for the laying of the foundation-stone of the new building to accommodate this institution which now occupies rented quarters. A piece of land to the north of the Presidency College has been taken up, which if the new Central Road is constructed will lie in a very prominent position. The plans for the building will consequently not take definite shape until the Road Scheme is settled. Meanwhile we learn that a tentative design is under preparation.

**SINGAPORE WATER-SUPPLY.**—A very important work in connection with the Singapore Water-supply was completed lately. The Municipality have during the last eighteen months been engaged in building a new outlet well at the Impounding Reservoir to replace the old one which had begun to shew signs of weakness, which rendered it a matter of the utmost importance that a new outlet should be provided without delay. The connection between the new well and the 24-inch main which supplies the Pumping Station, was successfully completed and the water turned on without accident.

**A FINE SPECTACLE!**—Extravagant expenditure, it is stated, was lately going on in connection with the Haputale Extension. Some six Engineers of the Executive Railway staff were at one time drawing handsome salaries without any employment, owing to the non-arrival of Mr. F. J. Waring, the Chief Resident Engineer, who has just joined. The sanction of the Secretary of State to the extension was made known in Colombo towards the end of March—seven months ago—and up till now not a sod has been cut, though the large staff of Engineers mentioned above has been got out from home.

**THE WEST OF INDIA PORTUGUESE RAILWAY.**—It is believed that the Railway will pay, since the shares are already at a premium, as is natural when the Portuguese Government guarantee 5 per cent. in perpetuity; but unless more capital is subscribed, of which there is no prospect now, and the breakwater at Marmagoa is completed, the great anticipations which attended the opening out of this route to the sea will hardly be fully realised. It is, however, no small thing that Portuguese India has done in guaranteeing 5 per cent. on the capital subscribed, which entails a charge upon them of no less than £50,000 a year.

**THE BALLY PAPER MILLS COMPANY, LIMITED.**—The Report by the Directors of the Company, for the year ended 31st July 1888, shews that the net gain for the year on Manufacturing Account was £23,506-10-5; from which fell to be deducted £2,958-16-5 for Calcutta Agents' Commission and Fire Insurance, and £1,049-5-6 for Income Tax in Calcutta and London, leaving a net surplus of £19,453-8-6, being equal to 20 per cent. on the paid-up Capital of £96,800, a very handsome result certainly, shewing that the business of the Company has been successfully and profitably conducted during the year covered by the Report.

**MYSORE P. W. D.**—The subordinate officers of the Mysore Public Works Department are now pretty well off as regards their salary and allowances. The Accountants are of the 1st, 2nd and 3rd grades, with salaries at Rs. 150, 100, and 80 respectively. The Supervisors are of three grades with Rs. 250, 200, and 150 respectively. The Overseers are of three grades also with pay at Rs. 100, 80 and 60. Those employed in the Malnad draw one rupee a day when at their head-quarters as batta, and three rupees a day when in the Districts. This arrangement has been sanctioned on account of the greater cost of living in those places.

**SIR C. ELLIOTT AT KURRACHEE.**—On the 15th November, the Kurrachee Port Trustees entertained a large party of gentlemen on board the steam tug *Manora* to meet Sir Charles Elliott, Member of the Supreme Council for Public Works, and Colonel Wallace, Director of the North-Western Railway, who paid a brief visit to Kurrachee. The principal business which Sir Charles Elliott had in view in visiting Kurrachee was, it is said, the settlement of the dispute between the Railway and Tramway Company, the latter being credited with demanding an exorbitant sum of money for the privilege of crossing its line required in the interests of the public by the Railway.

**RAILWAYS IN ASIA MINOR.**—The prediction that the granting of the concession for the railway from Ismidt to Angora would give a decided impulse to Railway construction throughout Asia Minor seems likely to be justified more speedily than even the most sanguine prophets might have expected. M. Bernard Maimon, who acted last year as the representative at Constantinople of Sir Alfred Kirkby in the negotiations for obtaining the concession for lighting Salonica with gas, has telegraphed to the Ministry of Public Works that a group of British capitalists intend demanding from the Imperial Government a concession for carrying forward the Angora line to Bagdad.

**KURRACHEE AND HOME IMPORTS.**—The ordinary imports from Europe are apparently not sufficient to ensure a full load being obtained every month in Liverpool for Kurrachee-bound vessels: but the Hall Line got over this difficulty by securing a contract from the North-Western Railway to bring out 2,000 tons of English coal monthly. It may be some years yet before the requirements of the Railway in this respect will cease; but looking ahead it may be possible to predicate that English coal will be driven out of the field as soon as the oil resources of Biluchistan and the Punjab are developed. When that time comes the Hall Line must either secure other freight at Home, or cease running their vessels to Kurrachee.

**A MUNICIPAL ENGINEER SHALL NOT OVERWORK HIMSELF.**—The draft agreement between the Singapore Commissioners and the Municipal Engineer was objected to by a Commissioner in the wording of the clause setting



forth "that the Municipal Engineer should not devote any portion of his time or attention which should or ought to be employed in the duties of his office to gratuitous work for any person or persons whatsoever without the sanction of the Board in writing." The Commissioner pointed out this might lead to the Engineer working at night, which time was necessary for the refreshment of his physical condition; he might devote hours which were required for rest, and thus his energies might be impaired during the day!

**CONSULTING ENGINEER'S OFFICE, LUCKNOW.**—Official intimation has been received abolishing this office so far as controlling the affairs of the O. & R. Railway; but it is further stated that the inspection duties of the Consulting Engineer are to be extended, and a system of railways consisting of no less than *four thousand miles* will, from the 1st January next, come under the charge of the Lucknow Consulting Engineer, the head-quarters of whose office will continue at Lucknow, but two Deputies need not remain at head-quarters. One it is suggested should be sent to Lahore and the other to Karachi. The scheme appears wild and ill-digested so far, but there appears to be some hope of the Lucknow Office escaping wreckage.

**COPPER MINES IN THE WESTERN DOOARS.**—The right of working the copper mines at Chunabatti, in the subdivision of Alipur, Western Dooars, will be put up to auction on 15th March 1889, and Settlement will be made with the highest bidder for five years. Chunabatti is situate two miles west of Buxa in the Western Dooars. Plenty of labor, firewood and good water is available on the spot. There is a good road, and the mines can be worked with little difficulty. It is believed that any person or company who may work the mines will obtain a good profit. Sixteen seers of copper are said to be obtainable from each bazar maund of ore. A specimen of the copper can be seen at the Office of the Secretary to the Chamber of Commerce, Calcutta.

**COCONADA WATER-SUPPLY.**—Mr. Cockburn, the Government Mechanical Engineer, thinks that the required water for the supply of the town and port of Coconada may be obtained from the canal and raised to the required level by means of an engine instead of constructing a masonry covered drain for five miles, in order to secure a higher level. The Superintending Engineer agrees with him, and recommends that Messrs. Burn and Co., Mechanical Engineers of Calcutta, may also be consulted and invited to make their offers for the supply of the necessary engines and other material for carrying out the work. They will be addressed on the subject, and on receipt of their reply, the whole scheme with all the details will be placed before the Government in due course.

**THE FACTORIES ACT IN BENGAL.**—The report on the operation of the Factories Act in Bengal for the year ending June last shews that the work of inspection was satisfactorily performed. There were thirty-three factories coming within the definition of the Act, of which thirteen were jute mills, four cotton mills, three Government military factories, and two dockyards, besides a jute press, a Railway factory, rice mill, silk factory, a shellac factory, a sugar refinery, an iron foundry, gasworks, and a paper mill. There were altogether 148 accidents reported during the year, of which 25 occurred in the Kidderpore dockyards. Of the total number of accidents only seven ended fatally. Children are only employed at the jute and cotton mills and the Army Clothing Agency, and the hours of work fixed for them are carefully observed.

**TRANSFERRED FROM BURMA TO MADRAS.**—The under-mentioned officers, of the Toungoo-Mandalay Extension of the Burma State Railway were reported as surplus, now that the Toungoo-Mandalay Extension is almost completed, and their services are no longer required. The Government of India, Public Works Department, Simla, has called upon the Chief Commissioner, Burma, who has, in turn, directed the Manager and Engineer-in-Chief of the Burma State Railway to instruct them as they become available to report themselves for orders to the Secretary to the Government of Madras:—Messrs. T. C. Beardsmore, Sub-Engineer, 2nd grade T. McReddie, Sub-Engineer 2nd grade temporary rank; H. Martin, Sub-Engineer 3rd grade; C. J. Rose, Supervisor, 1st grade; and W. Millie, Supervisor, 1st grade.

**INDIAN ARCHITECTURE.**—A globe-trotter thinks well of Indian architecture, considers that for color and surface texture, the materials at the service of an architect in northern India are splendid. He admires the combination of red sandstone with white marble, and the use of brilliantly colored Persian tiles. "In the blistering sunlight of India they do not look garish" he says. And, further on, of Sirkej: "Tombs of saint and King and Queen and Princes, mosque and exquisite pavilion, artificial lakes with palaces and stables, are barely occupied; but all shew the one conception of the artist, the one hand of the founder. Where to find their equal in Europe for perfect execution of a harmonious but complicated plan, for co-ordination of many buildings to one effect, for simple pathos and imaginative beauty, it would be hard to say."

**GUARANTEED RAILWAYS.**—If, as is said, language was given to man to conceal his thoughts, instead of giving expression to them, figures must have been invented as an auxiliary to prove anything and everything, and to distort facts into any shape. As a rule Government Resolutions are not very interesting reading, at best; nor are the majority of them conspicuous for lucidity. But when statistics are forced into requisition, confusion becomes worse confounded, and readers are left to find their own way out of a labyrinth of complicated figures. We have before us a Synopsis of Transactions connected with Guaranteed Railways under the Government of India for the year 1887, which, for rigidity of style, stands unrivalled. Taken all in all their working during 1887 may be considered satisfactory. The annual result in the last five years has risen from a loss of Rs 17,27,934 in 1883 to a gain of Rs 10,70,351 last year.

**QUININE MANUFACTURE AT DARJEELING.**—The report on the Government cinchona plantations, Darjeeling, for the past year, announces an important discovery which is nothing less than a process for the manufacture of sulphate of quinine, which is expected to produce permanent reduction in the market price of that expensive article. Experiments, we are told, have proved that by this process quinine can be obtained in a form undistinguishable either chemically or physically from the best brands of European manufacture. Although last year only 331lbs. were made, it is expected that large quantities will be soon turned out. The demand for the drug made at the factory, which is known as cinchona alkaloid, exceeded by 2,200lbs. that of the previous year. The net result of the year's work was a profit of Rs. 26,804, and there is good reason to expect that this sum will be considerably increased next year.

**THE INDIAN UNCOVENANTED SERVICE.**—As early as possible next year, the House of Commons is to be



asked to appoint a Select Committee to enquire into the claims of the various branches of the Uncovenanted Service in India. At a meeting of the London Committee, held on 31st October at the offices of the Uncovenanted Association in Pall Mall, a draft petition to be presented to Parliament was considered preparatory to being sent to the local committees throughout India for signature. It transpired that the dissatisfaction existing among the uncovenanted officers is greatly on the increase, and it is feared that unless something is speedily done to remedy the grievance complained of, the efficiency of the public service may be impaired. The depreciated state of the rupee is felt by all classes of Anglo-Indian officials, but especially by the officials of the Uncovenanted Service, who in respect also to furlough, retirement, &c., are placed at a considerable disadvantage as compared with military and "covenanted" officers performing exactly the same kind of duties.

**THE LUCKNOW IMAMBARA.**—The great Imambar at Lucknow is the largest room in the world, being an arched room without supports. The historian of Indian Architecture writes:—"This immense building is covered with vaults of very simple form and still simpler construction, being of a rubble or coarse concrete several feet in thickness, which is laid on a rude mould or centreing of bricks and mud, and allowed to stand a year or two to set and dry. The centering is then removed, and the vault, being in one piece, stands without abutment or thrust apparently a better and more durable form of roof than our most scientific Gothic vaulting, certainly far more easily made since it is literally cast on a mud form, which may be moulded into any shape the fancy of the architect may dictate." The Imambara was built by the Nawab Asuf-ud-daula. It was erected in the year of the great famine, 1784, in order to afford relief to the famine-stricken people. The magnificent ornaments and decorations which adorned the building have perished, but the Imambara stands a graceful monument of the monarch who erected it and who lies buried in it.

**BANNU RAILWAY SURVEYS.**—The propositions for the Railway to Bannu are:—(1) The route from Durya Khan station, *via* Dera Ismail Khan and the Pezu Pass, across the Gambila River, to Bannu. (2) The route from Mianwali to Kalabagh, thence *via* Esa Kheyl and Laki, to join the other route on the Gambila crossing. The proposition for crossing the river Indus near Dera Ismail Khan is to lay temporary lines of Railway to the bridges of boats which are established during the cold season yearly. With the exception of the heavy works through the Pezu Pass near Shakh Budin, the works are all very easy and present no special difficulties. For crossing the river Indus at Kalabagh a steam transshipping ferry is proposed, costing rather less than the temporary lines at Dera Ismail Khan, but with the advantage that the ferry can be easily worked all the year round, and constant communication across the river at this place can be ensured during the cold seasons; whereas at a Dera Ismail Khan rapid communication can only be ensured during the cold season as during the floods the rails will have to be taken up and traffic be conducted by steamers working from irregular landing-places, liable to be shifted almost daily. The cost of constructing the Railway to Bannu *via* Dera Ismail Khan, with a temporary line across the Indus and *via* Kalabagh, with a steam transshipping ferry, is about the same, but the cost of operating and maintaining the Railway *via* the Kalabagh route will be much less than by the Dera Ismail Khan route.

## Current News.

SIR GUILDFORD MOLESWORTH goes home in February.

COLONEL A. M. LANG, R.E., retires from the service on the 1st proximo.

LIEUTENANT C. F. CLOSE, R.E., has been placed under orders for duty in India.

MAJOR S. J. LAMBERT, R.E., reverts to Imperial duty, and proceeds to England.

The submarine cable has been successfully laid between Java and the port of Macassar, in the Celebes.

The line from Piynmana to Yemethen, Mandalay Extension, Burma State Railway, has been opened for goods traffic.

SIR CHARLES ELLIOT, the Public Works Member of Council, arrived in Calcutta on Tuesday morning for the season.

As soon as the new line to Insein is completed the local trains will, it is said, be furnished with the Westinghouse brake.

MR. CONDER, G. T. Manager, of the G. I. P. Ry., has received orders from the Home Board to take up the Acting Agency.

The new water-works at the Mhow Cantonment are far from proving the success and boon to the station it was hoped they would be.

The Duke of Connaught goes down from Poona to Bombay at the end of this week to go over the Harbour Defences with General Chesney.

It is proposed to extend the Inland Steam Vessels Act VI. of 1884 to the whole of Upper Burma, except the Shan States, with effect from the 1st December.

The Inspector-General of Forests with the Government of India leaves shortly on a tour of inspection in Assam, returning to head-quarters in March next.

COLONEL SANDFORD, Inspector-General of Military Works, visits Allahabad this week on behalf of the Government of India in connection with the new water-works scheme.

DR. SCHLICH, the Inspector-General of Forests, will not, we believe, return to India, having been offered the post of Principal Professor of Forestry at the Royal Engineering College at Cooper's Hill.

It is stated that one of the results of the recent Railway Conference will be a reduction in the number of classes, and improvements in the accommodation provided for Railway passengers in India.

MR. DOUGLAS has been deputed to Jamalpore by Mr. Campbell, the Agent, to examine the audit, traffic, and locomotive offices to see if retrenchments can be made without detriment to the Company's work.

COLONEL H. W. STOCKLEY, R.A., late Superintendent of the Gun-Carriage Factory, Bombay, has been permitted to proceed to Tasmania, where he has elected to reside and draw the unemployed pay of his rank.

Of the Forest Officers who are coming out to India from Cooper's Hill next month, Burma takes five, and Punjab, the North-Western Provinces, Bengal, the Central Provinces, and Madras one each.

An interesting discovery is reported from Chunar, the Military Works Department having chanced upon a cave-temple supposed to be two thousand years old, with images of the Hindu gods and some inscriptions.

The new ten-inch breech-loading gun, which is to be the corner stone of the Indian Marine Defences, has passed proof satisfactorily at last, and will be supplied as soon as it can be turned out in England.

With the approval of the Board of Directors, Mr. J. M. Sleater, M.L.C.E., will act as Agent of the B. B. and C. I. Railway during the absence of Major W. S. S. Bisset, C.I.E., R.E., on privilege leave, with effect from the 20th instant.

It is feared that the Mandalay Railway will not be open for passenger traffic in January, as was at first hoped. Goods traffic may possibly be carried on by February, but it is now thought that it will be April before the line can be made available for passengers.

The latest reports received from the Hyderabad districts are re-assuring. In several places rain has fallen and the cloudy skies indicate a further fall. The depression that was weighing down the villagers has disappeared, and all over there are indications of cheerfulness.



THE Royal Artillery barracks at Manora will be ready for occupation by the end of the current year, when the garrison battery, which is at present quartered in the Napier Barracks, will move into them, and a finer and more comfortable lot of buildings can scarcely be equalled throughout India.

Two survey parties for the Moo Valley will start operations, Mr. Beeston, Executive Engineer, is to have the first division from Sagaing to a distance of 130 miles up the Moo river, and Mr. Bagley, Executive Engineer, will be in charge of the second division from that point to Mogoung, with the branch line to Bhamo.

MR. E. R. HENRY, Collector of Chumparun, has been placed on special duty to supervise the relief operations which it is proposed to start in those parts of Behar where the rice crop has been a failure. The Director of Agriculture has also been instructed to proceed to Behar to confer with the Commissioner of Patna Division.

PREPARATIONS for Railway extension eastward from Kalutara are progressing apace, and the arrival of Mr. Waring at Colombo will, it is expected, expedite matters a good deal. The whole of the staff on both extensions have been appointed, the necessary buildings are in course of construction, and there is little to delay a commencement of actual operations.

THE petroleum obtained from the Khatan wells is at last to be utilised for fuel on the North-Western Railway. The idea of constructing a branch line to the wells from Sibi (80 miles) has been abandoned, as a result of Sir Charles Elliot's recent visit, on account of the heavy cost, which was estimated at about 22 lakhs of rupees. Camel transport will be used to carry the oil to Sibi.

THE following appointments made by Government of gentlemen to serve as members of the governing body of the Victoria Jubilee Technical Institute, Bombay, are notified:—The Honorable Mr. F. Forbes Adam, C.I.E., who is appointed Chairman of the Board; Major-General J. H. White, R.E.; Colonel G. L. C. Merewether, R.E.; Major W. S. S. Bisset, R.E., C.I.E.; G. Cotton, Esq.; and Nowroji N. Wadia, Esq.

## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

### THE PRESENT STATE OF THE INDIAN P. W. D. AND ITS PAST HISTORY.

#### V.

SIR,—There is, however, one fact which should be taken account of in connection with the concluding remarks in my last. It is needless to point out the loss of efficiency in the department resulting from the present hopeless feeling among the Engineers, and the widespread conviction that devotion to duty and exposure only carries the reward of having to take sick leave on furlough earlier. If this loss causes slackness of supervision to the almost inappreciable amount of one per cent., the loss to Government on some five millions of Indian expenditure is no less than 6 lakhs of rupees per annum at current exchange, a sum which would much more than pay for any retirement or enhanced pension scheme; and though I am not prepared to say that slackness exists, it is not improbable that it does. Prior to 1880, as now, no one would have ventured to make the charge, and yet as *Engineering*, 27th January 1888, pointed out, the 3,868 miles of Railway in India constructed since 1880, cost as low as Rs. 4,958 per mile, being 35 per cent. less than those constructed before 1880. It may not unreasonably be expected that, putting heart into all the P. W. D. men would bring about a still further reduction in these and other works, and possibly a small apparent increase in expenditure would be a direct economy.

The increase must, however, be but small. No scheme of wholesale retirements and sterling pensions can be other than illusory, especially at the present time, and any considerable and certain increase of direct burdens for the sake of indirect and uncertain results is economically defensible, although the position that Government is bound to accord the promised equality of treatment to all European officers of the Department, cannot be questioned.

The two main points to be aimed at in a re-organisation of the P. W. D. which shall be an effective one are:—

- (1.) Personal responsibility.
- (2.) Absolute equality for all men doing the same duties,

Several re-organisations of the Department have taken place at various periods in its history. As none of these (so-called) re-organisations ever went in the least degree to the root of the matter, and resulted in the substitution of a decentralised, elastic, and properly constituted civil system of organisation and administration, it is perhaps not surprising that they were not of the slightest use.

(1.) As to personal responsibility. At present regular promotion reports are sent up by Superintending and Chief Engineers

yearly to P. W. D. Secretariat and these are supplemented by "Confidential" reports from time to time on transfer.

Under this system, setting aside a few cases of wilful indulgence of personal dislike, there are three great drawbacks:—

(a.) That many Superintending Engineers will recommend everybody equally or nearly so.

(b.) That an officer does not know what are held to be his faults or failings.

(c.) That it encourages the temptation to study the peculiarities of each Superintending Engineer with the sole view of pleasing him.

The result to Government of the operation of these causes is, that they frequently receive glowing reports from one Superintending Engineer and damning reports from another about one and the same officer. When it would be so easy to introduce a different procedure, the retention of the present system can only be ascribed to military tradition. It takes a long time and varied charges to know, whether a man is a good regimental officer. An Engineer's work speaks for itself from the very beginning, and in no profession are the elements of chance and personality less disturbing. To ensure Government having facts to go upon instead of opinions, which, however well based, are still opinions only, it would suffice to append to each half-yearly report a brief account of the work each officer had been engaged upon, what assistance he had, its nature, difficulties, cost, attending circumstances and all other particulars, and the opinion of the Engineer-in-Chief upon it, this opinion to be supported by specific instances of special approval or disapproval. If adverse, that the officer should receive a copy and be allowed one reply, and one only, which must be based on the contravention of facts alone.

On a series of such documents, the Government of India could decide whether an officer was deserving of promotion or not, and on some such system alone can a system of promotion by selection commend itself to the Department at large. Under any other system, promotion by seniority is the only safeguard against wholesale jobbery. If every man felt that a complete record of his services was in the hands of Government, uninfluenced by the unknown quality of confidential reports, and that his past work was studied, a direct incentive to exertion, now greatly lacking, would be supplied.

The second great principle I have mentioned, is equality of emoluments for all doing the same duties. As long as men feel that whatever their exertions may be, they serve under rules which preclude advantages to them which are open to their more fortunate brother officers, and I have already so clearly shewn the inequalities at present existing that it is unnecessary to repeat them here. There is no doubt that Government acknowledge their promises, and would be only too glad to fulfil them did they see a way of doing so economically. They have repeatedly declared their confidence in their Civil Engineers. They have emphasised their declaration by putting all, or nearly all, the hard work of the Executive ranks into their hands. Every Canal or Railway that is opened is the occasion for the acknowledgment of their services. It is an erroneous view to take, that Government is opposed to the grant of deserved concessions, much less to the fulfilment of specific promises, could a method of doing so be seen.

I believe that in the proposal of the Public Service Commission to form a Provincial Department, such a way has been found, though the details of the scheme as laid down in their No. 1432G are, in my opinion, scholastic and unpractical. I put forward the proposals which follow, for discussion and criticism. There are great difficulties of detail, and on details depends success. I believe that the only means of arriving at a satisfactory re-organisation scheme, is again to call a representative Committee like that of 1883, composed of Royal, "Stanley," Cooper's Hill, Roorkee and Native Engineers and to fairly consider their recommendations, giving them of course financial limits.

But it seems to me that it would be quite feasible to conduct a re-organisation on some such lines as the following:—

I. The formation of an Imperial Service which should at first be based on *personnel* alone, and subsequently on district considerations, Provincial men being appointed to succeed Imperial men in charges not requiring the latter.

To the designation of Imperial it would be necessary to admit all men who hold the promises of equal treatment, and as I have shewn in my previous letters, this would be the Royal Engineers, the Stanley Engineers, the Cooper's Hill men, the men engaged in India with English training and, at all events, the Indian College men appointed prior to 1876. Those who entered after 1876 have no case either in law or equity.

This service should be recruited in the future at any permanent numerical level that the Indian Government may find necessary by appointments of the Secretary of State alone, and by special cases of promotion from the Provincial Service. It would supply Superintending Engineers to the Provincial Service and would direct and carry out all works calling for special professional skill. For purposes of promotion, all officers above the rank of Executive Engineer, 1st grade, would be kept on one list as at present, and all officers below that rank on their different lists as at present.

(II.) The formation of a Provincial Service.

This would conduct the ordinary work of maintenance of roads



and buildings and the ordinary current work of Provincial circles and Local administrations.

Its recruitment would be from the Indian Colleges and subordinates promoted, its limit of emolument about Rs. 800 a month, and its members capable in cases of very special and proved ability, of transference to the Imperial list. Its promotion to be, as before, by selection only, and the average promotion to work out to 6 years' retention of the highest grade at retirement. The present formation of this Provincial Department would not be an easy matter. No man who has joined the service up to date, could, with even a shew of justice, be deprived of the possibility of reaching the 1st Executive grade.

It would be necessary to lend men from the Imperial list to the Provincial branch on their present pay and prospects, until their places could be taken by others appointed regularly to the Provincial list direct.

The difficulty here would be that, men so lent would feel that their chance of rising in the service was materially lessened by the restricted field, and it is at this point that the greatest difficulty will be felt if the ideas of the Public Service Commission in this matter should be acted upon. But their retention on the Imperial list would give them the same claim to promotion as their contemporaries, *ceteris paribus*, or special terms such as an incremental scheme might be given to make up their emoluments to what they can, on actuarial data, expect to obtain under the present conditions of service. There are, moreover, known to be in the 1st and 2nd Executive rank various officers whom it is not intended to promote beyond that grade, and admission to the increment of Rs. 50 per mensem would induce almost all of these to take willingly the loan of their services to the Provincial.

The only additional expense which would be involved by the scheme I have very roughly outlined, would be that involved in granting the equality between Royal and Civil Engineers.

This equality involves three leading points:—

- (1.) Staff Corps sterling pensions.
- (2.) Service for pensions.
- (3.) Military pay.

Of these, the first two are the most important. It is not, as I before pointed out, just or necessary to induce men of ripe experience and still vigorous, to retire for the sole benefit of their juniors, and it cannot be expected that Government should, by offering special terms, endeavour to do so. At the same time, a fair and reasonable flow of promotion must be secured, and this would, I think, be met by offering men £250 at 20, and £365 at 25 years' service.

The additional expense herein involved would be small, as these pensions would after all represent the present conditions *plus* fixity in the matter of exchange, and if all classes of the imperial list were allowed to count four years furlough as service for pension in 30 years, and two years in 20, many would certainly take their pensions at 20 and 25 years' service glad to quit a Department in which they have been so disappointed.

Secondly, service for pension should be ruled to count in all cases from the date of engagement by the Indian Government. This would add periods of from three to six months to the "Stanley" Engineers, and as the R. E's. have under a recent order obtained the grant of one year's seniority for pension, while at Chatham to equalize their standing with Cooper's Hill Engineers on the score of the age of the latter, six months' service might be added to those Cooper's Hill Engineers who entered between 1872 and 1879, the Chatham course being 2½ years and the Cooper's Hill course 3.

Thirdly, as to Military pay. This is comparatively a minor matter. The Civil Engineers, as a body, have never been jealous of their Military brethren in this respect. It has unavoidably been put forward as one notable example of inequality of emolument, but the proposal to reduce it came from the Secretary of State. An equivalent to it might be given in three ways:—

- (a.) By granting correspondingly better pensions.
- (b.) By a contribution to the Provident Fund.
- (c.) By withdrawing it from future Military officers in the Department.

Of these three, the second seems to me much the fairest. It would be inadvisable to depart from the principle of equality in the matter of pension, or to offer higher sterling rates from an economical point of view. The Secretariat considers, *vide* Colonel Trevor's minute, that if \* Departmental service were rendered unpopular with R. E's. the finances would be burdend with 150 of these officers, for whom no employment could be found. There remains then the second alternative. As the Provident Fund exists in the place of the Widows' and Orphans' Military Fund and wound pensions, and the advantages to the Civil Engineer are but very slightly, if at all, in excess of investment in Government paper in the open market, the equivalent might well be given in the shape of a bonus at the end of service credited to the Fund for all members of the service alike, based on their whole departmental service.

These two grants would involve but a small increase to the present cost of the establishment.

VERITAS.

#### THE NUMERICAL STRENGTH OF THE P. W. D.

SIR,—Your correspondent "Veritas" gives the number of Engineers in the Department at present as 834. Does this include Madras and Bombay? In General Hannington's tables the total number given is 1,054 in 1886. Can anyone give the correct number of Engineers in the Department on 1st of January 1888?—divided as follows:—

R. E's. and other Military.	
C. E's. appointed in England.	
Do.	do. in India (English training.)
Do.	do. do. from Indian Colleges.
Do.	do. do. Natives of India.

In a scheme for a separate Imperial and Provincial Establishment by the Government of India in this year, the total number of Engineers is put down as 1,000, *i.e.*, 745 European and 255 Indian.

X.

#### THE BOMBAY WATER-WORKS.

THE appearance of the Report of the Municipal Engineer upon the Bombay Water-Works is anxiously awaited by the public, there being many things about the scheme that have for some time interested the people in the Western capital. Everyone, of course, must be anxious to know whether the works after they are finished will bring a sufficient supply of water without additional expenditure. Also, it will be interesting to them to know how long the works will last without being repaired, as it is not every day that a Municipality can afford enormous sums for its water—in other words, the public will be glad to learn that the work is being done in first-class style.

H. C. F.

#### INFORMATION WANTED.

SIR,—Will you kindly inform me who sell Mayfurth's hand thrasher, its price, and if it is used at the Nagpur Government Farms? Also if syphon pipes are used instead of service pipes for taking the water over the bunds of tanks in India; and if so, are they worked independently of machinery for exhausting the air, and what time elapses before the pipes become air clogged and stop working?

I am very anxious to get some of the best illustrated catalogues on sawing machinery, especially any suitable for sawing standing trees; also machinery for the manufacture of timber tea chests, and a catalogue on pumping machinery. I would be extremely obliged if you would get me, or put me in the way of procuring, the above.

D. E., P. W. D., Ceylon.

#### INDIAN ENGINEERING.

SIR,—Every Engineer who cares more for the matter than for money will gladly welcome the change in the rate of subscription you have proposed in your last number, as it will place you in a better position to carry out all your plans in the journalistic warfare you have undertaken.

With due respect to your object in keeping the rate so low, my humble opinion is that *such* a disparity in the rates between the rival journals goes a great way to increase the importance of that journal which has a higher rate than the other in the eyes of those who are ignorant of the actual cause, especially in the eyes of your foreign and Home readers.

A little more readable matter is not a bad inducement to pay more. As for myself, you may count upon my continuing to be one of your subscribers.

Wishing you every success and your Journal.

EXECUTIVE ENGINEER.

[We have received several communications all more or less to the same effect, and the cry is still they come!—ED., I. E.]

#### "STRANGE ARE THE WAYS OF GOVERNMENT."

SIR,—Under the heading of "Notes and Comments" in your issue of 24th November remarks are made about the strangeness of the ways of Government in connection with the *Rangoon Times'* observations on Dr. Noetling's deputation to Burma which are unfair to my colleague. Though it is perfectly true that Dr. Noetling is the Palaeontologist of the Survey, it is evidently quite beyond the conception of the *Rangoon Times*, and indeed, as I have found, beyond the ken of many other newspapers, that

\* This document will be reproduced *in extenso* as an "Official Paper" in an early issue.—ED., I. E.



a paleontologist may be, and is as regards Dr. Noetling, a man of experience in other branches of geological research. In the selection of the officers of the Survey, considering that India is a comparatively new country as regards all branches of this research, due care is taken that they shall as much as possible have gone through mining experience; and as it happens Dr. Noetling did have considerable experience in the mining branch of the German Geological Surveys, in the very minerals which Burma is supposed to be rich in; so a numismatist, however well he may be versed in the old monetary utilization of the metals, need not so necessarily be adapted for this work as my Paleontologist, who so far has proved himself quite up to the work required of him in Burma. I can keep the flora and fauna of lost worlds a little longer in our work rooms in the interests of the public as regards a prospector and a mineralogist: but I know nothing of the qualified man on his way out, though the fact remains that a very specially qualified man in the shape of Mr. Hughes has just gone to Burma.

WILL. KING, D. Sc.,

Director, Geological Survey of India.

CALCUTTA; November 24.

### TREVOR'S FORMULA FOR FOUNDATION.

SIR,—The elaborate calculation taking up a page and a half of your issue of 29th September by Major-General W. S. Trevor, R.E., does not appear to me to be a *formula* at all, but a simple schoolboy sum in mensuration, to find the weight of a wall.

The whole problem turns on the safe load per square foot, which different kinds of soil are capable of bearing: this is dismissed by General Trevor in a very airy way: he says "in ordinary cases it will not be necessary to go into this calculation, as the pressure on the soil will generally be slight"—but surely whether it is slight or excessive depends entirely on the width of foundation  $b$ , the unknown factor which he is trying to find: also how can his formula be used at all unless this pressure on the soil be first either found by experiment or assumed.

In the example given, 1 ton per square foot is assumed, but why? In the case of the loamy soils usually met with in Upper India, I opine that  $\frac{1}{2}$  ton per square foot is the utmost that should be allowed, in which case the width of foundation  $b$  becomes 15.5 feet instead of 10.17 feet, a not inconsiderable difference. This is an important subject on which most text-books are silent, and if any of your correspondents could throw any light on it, it would be very welcome to those who have the design of tall chimney shafts, towers and other lofty buildings.

W. J. W.

[We have already recognized the importance of the subject, and now publish the first instalment of a series of articles which will practically exhaust it.—ED., I. E.]

### THE ORISSA CANALS.

SIR,—The Orissa Canals do not, and perhaps never will, give good interest on the large amount of capital sunk in them.

Their future utility, however, as a means of communication, will not be ignored when Orissa, the most backward and lethargic province in India, begins to make some advance—while their present efficiency as a famine insurance scheme cannot be questioned, in this, a year of poor crops and scarcity throughout many districts in India.

Not only do they give a living to the large number of laborers annually engaged on maintenance and repair works, to a large number of paid servants in "constant employment," to a large number of boatmen who would otherwise be unoccupied for the greater portion of the year, and indirectly to many boat builders and rope makers, &c., but they also supply good water for drinking and domestic purposes to the numbers of people living along their banks—and what is all important, they make two grains of rice grow where otherwise in bad seasons there would only be one, or none at all. Now this year, in parts of Orissa, in Banki and in Khoorda, Government was forced to give small grants, and open relief works as great scarcity and suffering were apprehended owing to the partial failure of last year's crops and the improbability of good ones this year.

In the Jagepore sub-division and in other parts very poor crops will be reaped and prices of foodstuffs have gone up considerably. In Ganjam, a Madras district bordering on Orissa, it was even found necessary to call out the military to stop rioting and prevent the looting of the grain dealers' stores, numbers of people having neither food nor hopes to live on through the rains breaking much later than usual and not falling when most wanted.

Over the canal area, however, nowhere is less than a twelve-anna crop expected where canal water was freely resorted to, and

this compares favorably with the four-anna or six-anna crop expected in other parts.

Therefore the value of the canal water cannot be over-estimated, and it affects a very large area in three ways:—

(1) It provides food for our cultivators using canal water.  
(2) It enables such cultivators to realize good profits for their surplus produce owing to the ready means of communication by reason of the canals.

(3) It tends to keep down the prices in adjacent parts of Orissa as well as in neighbouring districts, and thus prevents a scarcity developing into a famine over a large area.

No doubt in time when the distributing channels on the Tal-dundah, Gobree Patamoondee and High Level Canals are provided a large percentage of the half a million of acres actually commanded will be constantly leased, but even the lakh and a quarter, the area irrigated this year, is not bad considering the Ooriya's disposition, his fondness for hoarding, his unwillingness to part with money for paying water-rates, his faith in the hopeful predictions of his priest, and most of all the uncertainty of the rainfall.

Supposing forty rupees to be the value of the produce of a twelve-anna crop and twenty rupees the value of a six-anna crop; twenty rupees will then represent the increased value of the crops due to canal water and over an area of one lakh and a quarter of acres, the value of the additional out-turn will be no less than twenty five lakhs of rupees. From this, of course, the water-rate of Rs. 1-8-0 per acre must be deducted—say two lakhs—leaving twenty-three lakhs as profit distributed amongst the irrigators.

Knowing the long consideration required before a water lease is applied for, this might appear an exaggeration, but as in Shahabad the improved material condition of those utilising the Sone Canals for irrigation purposes is seen in their tiled houses, so in Orissa the greater prosperity of those living in the canal area and resorting to canal water is shewn by their wearing better clothes and bedecking themselves with many more silver bangles and other valuable jewellery. The utility of the canal water in a season of drought is directly appreciated by the cultivators, but it is only indirectly felt by non-cultivators, it being impossible to indicate the effect of the large additional yield in keeping down the prices—prices without which yield would be fifty or a hundred percent. higher.

The value of the canals for navigation purposes need not be dwelt on, without them in Orissa—a province with few good roads—the surplus rice in many villages would be left unsold.

X. Y. Z.

### THE ACCOUNTS BRANCH, P. W. D.

#### II.

SIR,—Two Accountants of the present *second* and *third* grades should be attached to each Executive Division, and to large Sub-Divisions one Accountant of the third grade should be attached. These Divisional Accountants should compile the divisional accounts in the same or similar forms to those at present prepared by Examiners, while the staff attached to the Provincial Accountant-General would prepare the entire accounts of the Province in the same or similar forms to those at present prepared by the Accountant-General, P. W. D. The duties of the two Divisional Accountants; one would have charge of all the current work of the month, while the senior would compile the accounts for submission to the Head Accountant of the Province attached to the office of the Provincial Accountant-General. The fourth grade of Accountants should be abolished altogether, and this abolition and reconstruction should take place from the 1st April 1889.

As the beauty and perfection of machinery consists in the fewness and simplicity of its parts; the scheme herein sketched, may therefore modestly claim to have introduced as few parts as possible, which it is confidently affirmed would be found to work more smoothly than the present cumbrous and unmanageable machinery.

In the proposed reconstruction of the Accounts Branch, only those of the present Examiners who have risen from the grade of Accountant should be retained, for the simple reason that it is not Examiners but Accountants who are really necessary. This primary fact should be borne carefully in mind. Now, with regard to the pay of the Head and other Accountants, I think the former might commence on Rs. 800, rising to Rs. 1,500, which, latter, would be the maximum pay that could be attained. The other Accountant I would leave on the present scales of pay attached to the first, second, and third grades, respectively.

Under the proposed scheme *all* vouchers would remain in Divisional Offices. This of itself would diminish the present multitude of forms, for instance only *one* voucher for each payment would be submitted by Sub-Divisional Officers, instead of *two* as at present. No vouchers whatever would be submitted to the Head Accountant, who would simply compile the accounts received from Divisions into Provincial forms, which again would simply be transferred into Imperial forms in the Office of the Secretary to the Government of India, Financial Department, or whoever prepares



the Indian Accounts for submission to Parliament. From the foregoing it will be inferred that, the proposed scheme contemplates the early amalgamation of the Military Works with Provincial Works, which has been under consideration for some time past. This much-needed amalgamation should have simultaneous effect with the reconstruction of the Accounts Branch, that is, from the 1st April next. In proposing six Accountants to be under the Provincial Head Accountant, two are intended for accounts of the Irrigation Branch, two for the accounts of the General Branch, and two for the Military Works Accounts. If the Military Works Accounts are to be still kept separate from the Provincial Branch, then only four Accountants would be necessary under the Head Accountant, but as there is not the slightest excuse for keeping the Military Works separate from Provincial, the amalgamation should be carried out without further delay. Military men, however, being still retained in, and for, Cantonment work, this refers to both Officers and Subordinates.

The proposed scheme would also relieve Executive Engineers of all the worry they have at present with purely matters of accounts. They should have nothing whatever to do with accounts; any glaring excess on sub-heads of estimates would be as at present brought promptly to the notice of the Executive Engineers by the Senior Divisional Accountant, the Executive Engineers would then promptly call the attention of the Sub-Divisional Officers to the fact who, as in duty bound, at once rectify the matter; but no petty matter of slight excesses on the sub-heads of estimates should ever be referred to Sub-Divisional Officers who are frequently over-worked out of doors with their legitimate duties.

In the foregoing, the term "Province" means and includes Bombay, Burma, and Madras, as well as Bengal, the N.-W. P. and Punjab. The minor administrations under the Government of India might be grouped together as one province.

It may be asked if the proposals herein indicated were actually carried, what on earth would you propose doing with the present so-called superior officers of the Accounts Branch? To this I reply the Military Officers at present in the Accounts Branch never had any business to be there at all; and consequently are easily disposed of; let them return to their legitimate duties. Should any of them be unfit for active duties, there are still two courses open to them, half-pay, or retirement, just as they may choose themselves; while as for the superior Civilian Officers the Railways would probably absorb some, if not all, of them; but in Railways as well as the other Branches of the Indian P. W. D., it is not Examiners, Deputy and Assistant Examiners, who are really wanted; it is working men, Accountants who are really necessary. In any case all affected by the proposed change should be dealt with liberally. All entitled to, or within five years of, pensions, should receive them, others of less service should receive liberal bonuses.

With regard to the proposed work of the Committee at present considering how the number of forms may be best diminished in Executive Engineers' Offices, I really see no other solution but that suggested. I am unable to see how the Forms of P. W. Accounts as printed in book form in 1866, can well be dispensed with.

The P. W. D. will always require its own peculiar forms of account, but these should be diminished from triplicate to duplicate, or even to single copies if possible, and in this direction only can I see or hope for diminution of forms.

E. B.

#### BRAKE TRIALS ON FRONTIER RAILWAYS.

SIR,—Mr. S. T. Gresham, of the Vacuum Brake Co., in his letter of the 31st October, considers your article on the Brake Trials near Quetta, misleading; first, because the Westinghouse brake, in making an emergency stop, broke a coupling, and second, because the air pressure at that stop was, he alleges, 150lbs. to the square inch. The fact is that the coupling which broke had not a sound piece in the fracture, and was quite unfit for use. But even had this coupling been as sound as it was unsound, the ordinary mortal, as well as the practical Railway man invoked by Mr. Gresham, knows that such an occurrence in an emergency stop, in order to prevent a collision, is of small consequence compared with the distance in which a train is stopped. The loss of even one second in the rapidity of the brake application might obviously entail serious loss of life.

Regarding the suggestion that the excellent work done by the Westinghouse brake was due to such a high pressure as 150lbs. per square inch, the fact is that the pressure in the reservoirs did not exceed 75lbs.; but if, as is to be inferred from Mr. Gresham's remark, there is such an immense advantage in high pressures for making such quick stops, what is to be expected from the Vacuum brake, which commands only from 8 to 10lbs. per square inch?

Mr. Gresham also says that the Westinghouse train in making another stop was broken into three parts, but he omits to state the circumstances. The fact is that on this occasion the brake was applied *lightly* from the guard's van, steam being kept on the engine, and as the driver had been warned not to touch the

handle of his brake valve, the brakes on the front portion of the train were released, and this naturally brought a great strain on the couplings. Each portion stopped a few yards from the other and the incident afforded a pretty and instructive experiment. The method of applying the brake in this instance was improper, but several other stops were made from the guard's van very successfully, the steam being kept full on the engine.

The exceptional length and weight of the Westinghouse train should be remembered, and when similar experiments have been made with a Vacuum train under similar circumstances, practical Railway men will be better able to make comparisons.

Mr. Gresham remarks that "with regard to the length of trains worked by both systems of brakes they were exactly the same as far as the brakes were concerned, as each train was filled with twenty-six sets of apparatus." This is a curious admission, and implies that so far as bogie carriages are concerned, double the number of Vacuum apparatus is necessary for the same actual length of train. Although this is certainly the fact, one would have thought it superfluous for the Vacuum Brake Co. to draw public attention to such a palpable element of weakness in their system. The Westinghouse train was composed of engine, tender, 24 long bogies, and 2 vans, weighing 575 tons, and was 471 yards long. The Vacuum train consisted of engine, tender, 6 long bogies, 10 four-wheeled carriages and 4 vans, weighing only 326 tons, and was only 265 yards long. It can, therefore, hardly be said that the two trains were exactly the same in any respect. The Vacuum bogies were each filled with 2 sets of apparatus, whereas the Westinghouse had as usual only one set; and had the Vacuum train been composed of similar vehicles as those in the Westinghouse there would have been 50 sets of brakes instead of 26. Are we really to believe that the weight and length of a train is a mere detail? The fact is that the great difference between the various forms of brakes, is in their capacity for working over long distances, and in this respect, amongst others, the Vacuum brake has been found wanting. Moreover, if only the number of sets of apparatus in use has to be considered, then we must understand that the Vacuum Company would consider 50-6 ton wagons, 18ft. long, fitted with the Westinghouse, as the equivalent of 50-12 ton carriages each 36ft. long, equipped with the Vacuum, one set of apparatus only being required in both cases. Yet the latter train would be twice as long, and would weigh twice as much as the former.

It is also stated that with the Westinghouse a special inlet valve must be added on every vehicle as well as with the Vacuum for long trains. This is entirely incorrect and misleading. The fact is that in the latest improved form of Westinghouse brake, the action has been made more simultaneous for emergency stops by a device which forms part of the standard fittings for both long and short trains. The air in the brake pipe, as well as that in the reservoir is employed to do effective work in the cylinder without any outlet to the atmosphere; whereas the method suggested for accelerating the slow action of the Vacuum brake is the old system of having inlet valves opening directly to the atmosphere on each carriage. No long train has yet been run with such an arrangement, and in practice it is not likely to be a success on account of the difficulty to be apprehended in graduating the brake, as well as in releasing it. In the Westinghouse system there is an outlet from the pipe to the cylinder, instead of to the atmosphere as before; in the Vacuum there is to be an inlet directly from the atmosphere, carrying in grit and dirt, &c. Until something is known of this new modification in practice, it would be better not to state that the Vacuum brake on 50 coaches is quicker than the Westinghouse, which Mr. Gresham asserts takes more than 3½ seconds for full application. It was found in the United States that the brake was full on at the rear of a train 2,000ft. long in less than 2 seconds, and in the recent short train experiment on the frontier, it was seen that the application of every brake block was simultaneous with the opening of the engine-driver's valve.

Mr. Gresham concludes with a statement perhaps as extraordinary as any in his letter. It would seem that it has now been discovered that India-rubber in connection with the Vacuum brake, does not deteriorate like other rubber in the Indian climate, and that my suggestion to the contrary has been disproved by the 5 years' experience of the G. I. P. and B. B. and C. I. Railways. First, the G. I. P. has only one train running with the Automatic Vacuum brake, and it is seldom worked continuously; and is Mr. Gresham certain that the packing rings have been working 5 years on this line? Second, the brake on the B. B. and C. I. Railway is the simple Vacuum brake, and need not be dragged into the discussion. The rubber packing has certainly not been an unmitigated success in England, as the Brake returns prove; and as regards the results on the Bolan train, it is the fact that after only 2 years in India these packing rings were found defective, and were all replaced by new ones for the recent trials. Most of the old ones were melted up.

In conclusion, Mr. Gresham has endeavoured to explain how the Westinghouse brake managed to stop so quickly, but he has omitted to explain how the Vacuum brake stopped comparatively so slowly. Reducing the stops of both to a common speed basis, it was found at the recent trials that the Vacuum train ran 50 per cent further than the Westinghouse, even when the length and weight of train was so greatly in their favour. How was this?

GEO. A. GUTCH



## General Articles.

### THE PESTONJEE CAMA HOSPITAL, BOMBAY.

This institution, of which we annex an illustration, occupies a site comprising 19,000 square yards, is situated near the New Elphinstone High School on Cruckshank Road, and the foundation stone was laid on the 22nd of November 1883 by H. R. H. the Duke of Connaught, the building being completed and formally opened by His Excellency Lord Reay on the 30th July 1886.

The Hospital was designed by, and erected under the superintendence of Khan Bahadoor Muncherjee Cowasjee Murzban, A.M.I.C.E., and is a credit to his skill and talent.

The design is Mediæval Gothic, and the building is principally constructed of stone, the general facings being of blue stone, and the dressings and carvings being made from materials supplied from the quarries of Porebunder. The entire length of the building is 265 feet and its total width is 125 feet. There are verandahs in the front and rear of the building running throughout its whole length, the one in front being enclosed to keep off the sun and rain. In the rear are the bath-rooms and lavatories which are approached by a covered passage, and on the first floor there is a terrace where convalescents may take the air. An additional floor placed over the central portion forms the principal feature of the edifice and serves to complete its symmetry. The floors of the Hospital are paved with Minton tiles and the walls of all the rooms and wards are lined with similar tiles to the height of three feet from the floor.

The utility of this Hospital is unquestionably very great, and Mr. Pestonjee Hormusjee Cama, who contributed a lakh and a quarter towards defraying the cost of its erection, has rendered himself a true benefactor to his fellow citizens, by whom his philanthropy will always be held in warm regard and veneration.

Government bears the charge of the permanent maintenance of the Hospital, which is one of the first fruits of the movement originally started by Mr. Kittredge and Mr. Sorabjee S. Bengalee, C.I.E., for supplying medical aid to the women of India.

XENOPHON.

### AKRA BRICK EXPERIMENTS.

WITH AN INTRODUCTORY NOTE BY H. LEONARD, M.I.C.E.,  
Late Chief Engineer P. W. D., Bengal.  
*Weight on Foundations of Buildings.*

THOUGH few, if any, of our buildings in Bengal have fallen, many of them cracked, some of them badly. On commencing several new buildings in Calcutta last year, we naturally considered the question, whether we could do any thing to prevent bad cracks and settlements. The cause of both settlements and cracking seemed to be the compression of the soil under the buildings, and taking this view of it, the question arose, what is a safe weight to put on this Bengal alluvial soil without causing serious disturbance of it? Finding nothing at all reliable on the subject, we decided on making a small series of experiments at Akra, where facilities were available or near at hand.

2. *Series No. 1* gives the result of the trials made. The scale on which they were made was not a mere toy scale, the piers of masonry dealt with were such as might be used on real work, and though the results may not be an infallible guide, they certainly do give definite information; they show, beyond doubt, that, with a weight of one ton to the square foot, the compression of the earth is very small, in fact, what might be due to disturbance of the surface in opening the foundations; while with two tons to the foot, sinking is decided, quite enough to cause bad cracks. If one part of a building were built with a load of one ton to the foot, and other parts with a load of two tons to the foot, the building would certainly crack, and if other parts were built with a weight of three tons to the foot, there would be very bad cracks.

3. I consider that safe conclusions to draw from the results of the experiments are these. If it be desired to provide against sinking the whole structure, the weight per foot on the earth, whatever may be the depth at which the foundation is laid, should not be more than one ton per square foot; and that, if *unequal sinking cracks* are to

be provided against, the weight on all parts of the foundations should be equal per square foot, unless that the most heavily loaded portion carries less than one ton per square foot, with this weight, and of course with lighter weights, no perceptible compression takes place, and hence no unequal settlement would occur from unequal loading.

#### *Depth at which Foundations may be laid.*

4. The next point for experiment was,—at what depth is the soil best fit for building on? We had trials made at depths of *two feet six inches*,—that is just below the usually disturbed soil; at *four feet*, where the true alluvial deposit was undisturbed; at *eight feet* where a different though not better soil was touched, and at *eleven feet*, where the soil was wet and soft. All through this series the effects of weight per foot considered in the three paragraphs above were kept in view. *Series No. 1* gives also the results of the experiments.

5. The conclusions which may be drawn from the results of these trials are not so clear as they are in the case of the weight on foundation; but it is evident that shallow foundations have the disadvantage of being affected by climatic influence, as heavy rain caused the masonry laid at a depth of two feet six inches below the surface to sink considerably. Again, it appears that foundations laid at a depth of eleven feet below the surface sink more than those laid at depths of four feet and eight feet. This is difficult to explain. It may be that, when the foundations are opened to a depth of eleven feet, the bottom, relieved of such a weight of earth, “blows up” a little, though hardly perceptibly and the first effect of weighting it is to force the blow-up surface down to its original state, and that, when thus pressed down to what it was before the earth was removed from it, may bear pressure as well as the earth at smaller depths. The conclusions which I am inclined to draw from the experiments are these:—The foundations of important buildings should be laid so deep that they cannot be affected by climate. The ground, if undisturbed, is as good at a depth four feet below the surface as it is at greater depths, and it is about the same up to eight feet deep. I would lay it down as a rule that in undisturbed alluvial soil foundations of *important buildings* should not be laid at a less depth than four feet, nor at a greater depth than six feet.

#### *Strength of Spread Foundations.*

6. Having settled on one ton to the square foot as the weight to be carried on the soil, it became necessary to spread out the foundations a good deal to get the area required, and then the question arose, at what angle should they spread, or what depth of masonry should there be at the weakest point? Some sections of foundations which I saw seemed to me to be too weak. In order to help to settle the question I had the experiments *No. 2 series* made; the result may be practically stated thus,—for a pressure of one ton to the foot, on Bengal soil, the thickness at the toe of the slope should not be less than one foot six inches, (*see record of experiments*) and the stepping at an angle of not more than 45°. I take one foot six inches because with a thickness of nine inches the projections broke off, as shewn in the sketch in the record of experiments; while, with a thickness of one foot nine inches, no symptoms of weakness shewed, even when the work was fresh. With good masonry, of mortar, which will set in damp or wet, I feel certain that the dimensions given above are enough, but with bad masonry—bad from whatever cause—considerably more strength should be given.

7. I think it likely that this question of footings *breaking off* has not been sufficiently attended to; the result of such an occurrence can be seen by looking at the sketch in experiment No. 1 of this series, where, instead of an area of twelve feet, that is the width of the footing by two feet long to rest on, the area is reduced by the outer-sides breaking off to less than half, that is, to the width between the cracks, by two feet; and instead of a weight of one ton per foot on the foundation soil, we should have a weight of over two tons, which means a subsidence of two or three inches, and cracks of probably the same width.



INDIAN ENGINEERING.

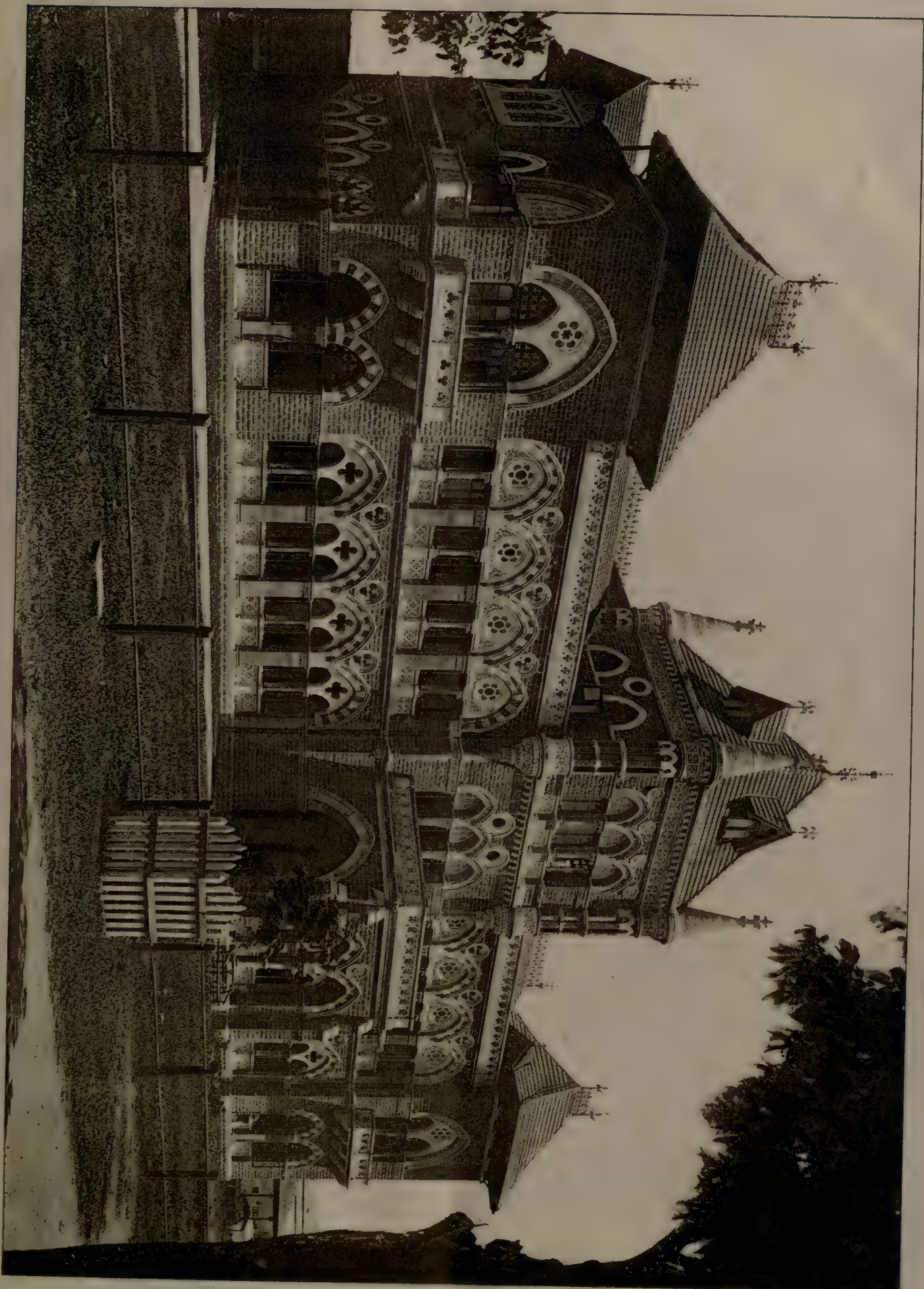


Photo-Tint by James Akerman & Queen Square, London, W.C.

THE CANA HOSPITAL.  
DOOR







Experiments made at Akra for the purpose of testing what weight the ordinary undisturbed alluvial soil of Calcutta, which fairly represents Lower Bengal soil, can bear.

FIRST SERIES.

Number of Experiments.	Depth below surface of ground.		Size of Pier constructed.		Total height of Pier.		Materials.	Total Contents of Pier.	Weight of Pier at 100 lbs. & c. ft.			Superficial area of Pier.	Age of Pier.	Load, excluding weight of Pier.			Weight per sq. ft. including weight of Pier.			Result of Loading.		Remarks.	
	Ft.	In.	Ft.	In.	Ft.	In.			Tons.	cwt.	qr.			lbs.	Tons.	cwt.	qr.	lbs.	Days.	Sinking.			
1*	1	4	3	2½	2	11½	Bricks with mortar, two of soorkie to one of lime.	30.88	2	3	0	8	41	0	0	0	4	3	3	13.8	1st 2nd 3rd	1½ ... 3½	The pier sank 3½ inches with this load by compressing the ground on which it stood; the surrounding ground was not visibly disturbed, except for a distance of about 2 or 3 inches immediately in contact with the pier, which seemed to be caused by the friction of two sides, the load being slightly in excess on those sides. From this experiment it would appear that only the ground under the masonry sinks, the surrounding ground not being disturbed to any appreciable extent.
2†	2	6	3	2½	5	0½	Ditto	51.89	2	6	1	9.4	10	7	3	8	1	4	2	20.3	1st	1½	Immediately on lowering screw jacks.†
3	2	6	3	2½	5	0½	Ditto	51.89	2	6	1	9	20	14	2	19	2	4	3	5.6	2nd 3rd 1st 2nd 3rd 4th 5th 6th 7th	1½ 1½ 1½ 1½ 1½ 1½ 1½ 1½ 1½	On lowering screw jacks.
4	2	6	3	2½	5	0½	Ditto	51.89	2	6	1	9	31	1	2	3	3	4	3	17.2	1st 2nd 3rd 4th 5th 6th 7th 8th	5½ 5½ 5½ 5½ 5½ 5½ 5½ 5½ 6½ 7½ 7½ Not measured.	Ditto ditto.  Very heavy rain fell on the night of the 4th. The sinking of this block is considerably more than in experiments which were 4 feet and 8 feet respectively below the ground level; a good deal of rain fell during the time this experiment was in progress, and the soil to the depth of foundation was no doubt saturated. It shows fairly the danger of shallow foundations.
5	4	0	2	9½	5	9	Ditto	42.12	1	17	2	12	7	16	3	21	1	5	0	4.3	9th 10th 1st	7½ 7½ 1½	Immediately on lowering the screw jacks. No further sinking took place with this weight for a space of seven days.

\* The object of this experiment was to ascertain whether the ground under the masonry alone is compressed, or whether the compression extends for some distance round the foundation.

† The object of this and the eleven following experiments is to show the compression of the soil at different depths, and under different weights.

‡ The frame carrying the load was supported by screw jacks at each corner during the work of loading; when the desired load was on the screw jacks were lowered, and the load was brought to bear on the masonry.

(To be Continued.)



## RIVER CHANGES IN BENGAL.

BY J. D. BEGLAR, C.E.,

*Archaeological Surveyor, and late Executive Engineer of Ancient Monuments, Bengal.*

## I.

IN the January number of the *Nineteenth Century* appeared an article entitled "A River of Ruined Capitals," from the pen of Sir W. W. Hunter; we shall not attempt to offer our meed of praise to the pages as charming as they were instructive, contenting ourselves more humbly with acquiescing in the appreciative encomiums already bestowed on it by others, but the article, more than merely instructive or charming, is suggestive and has turned our attention to the subject of river changes in Bengal, from the Engineer's point of view. The study of these river changes, is not merely of interest to the antiquarian nor is its merit confined to evoking feelings of sympathy and philosophic humility by vivid pictures of the decay and destruction wrought upon the works of man and men's rulers; the entombment and desolation of cities and capitals by the slow, silent, surely resistless forces of nature; the present and deeply humbling proof of man's nothingness. The study may have the further merit of stimulating inquiry as to whether these stupendous, if insidiously slow, forces may not by the ingenuity of man be utilised for the needs of the present.

That the antiquarian's study of river changes may be of practical use to the Engineer, can be illustrated by the instance of such changes in the Hooghly (Bhagirathi) and its tributary the Damuda.

Rising in the Chutia-Nagpur District, the Damuda flows through an undulating and high country, debouching on the flat levels of Bengal, a little above Burdwan; no changes were possible in the river-course above Burdwan, but the first great change appears to have taken place almost at the instant it became possible.

The course of the Damuda has remained practically unchanged since Rennell's time, owing to our system of embankments. Rennell's map, (annexed) however, shews a branch from the present course, starting near Burdwan and flowing almost due eastwards past "Bykontpour" (then an important village, now the little village of Boikantpour in modern maps) close past "Santgutehy" (still an important village, spelt "*Satgatcheah*") then turning north-eastwards, finally flowing into the Bhagirathi at "Mirzapour." A few miles above its outfall, it receives the united streams of the "Curree" and a small offshoot from the Bhagirathi, sending out a branch southwards, which flowing past Culna entered the Bhagirathi a little above "Ballagurry," the present Balagarh.

The stream so traced from the Damuda at Burdwan to Mirzapour is named the "Bonka" by Rennell.

It is still called Banka (the sinuous) in modern maps. The first tributary it receives is the Sapjolar, the next the Moya (not shewn in Rennell); it still receives also the Khureah (Rennell's Curree) and still flows into the Bhagirathi (better known as the Hooghly) at Mirzapour; but it no longer receives any waters from the Damuda, except perhaps in high floods, or when the embankments burst: it now depends wholly on the local drainage of Bagha and Shahabad till its junction with the Khureah.

A few miles lower down the Damuda, at Salimabad, another branch is shewn by Rennell as separating itself from the Damuda flowing south-eastwards, then with a long sweeping curve, turning north-eastwards, and falling into the Ganges a little above Triveni ghat. It receives one tributary on its course, and sends out one branch to join the Saraswati (not named however in Rennell's map) flowing due south. This Salimabad branch of the Damuda is named "Old Dummoodah" by Rennell.

It still runs in substantially the course marked out by Rennell, falling into the Ganges at Noaserai, but our bunds run across it, and it now probably receives no water from the Damuda except in floods or when the embankments burst, and what it may receive by percolation; but it is no longer known

as old Damuda in our maps; our modern maps call it the "Kana" and the "Koontee" in different parts of its course. Except in the memory of old people, its original name of Damuda appears to have been forgotten.

Rennell's map was published in 1779, based upon surveys that had been executed a few years earlier: the modern map, which has wholly altered and forgotten the very name of Damuda, is dated 1863—less than a hundred years has sufficed to obliterate the name.

But when Rennell surveyed for his map, the stream was already "old" Damuda; shall we be too far wrong then if we assign the beginning of the silting up of this "old" Damuda to some time in the 17th century?

There is nothing to shew when the Damuda first began to flow down this channel; all the maps can tell us is that somewhere about 1750 it had already been almost wholly silted up, and the main channel was flowing down towards Hooghly Point.

We shall in a subsequent part of this paper, when discussing the general question, discuss the possible conjectural reason of the silting up; at present we shall confine ourselves to this illustration of the service that apparently unpractical antiquarian research may render to the practical purposes of a later time.

The existence of a channel similar in general features to this silted-up channel of the Damuda that as late as 1779 was in direct communication with the parent river might lead to the conjecture, that at some earlier period, before the Salimabad Channel had become the Channel of the Damuda, that other, *viz.*, the Burdwan Channel might have been the Damuda. It would, however, be a mere conjecture, and we have not come upon any records furnishing any information on this point.

But where maps and records fail us there is the unfailing record of river deposits; the alluvial deposits of the Bhagirathi and of the Beoleah Nalas, (as the southern branch of Rennell's Banka is now named) are so different in color, and material from the deposits of the Damuda, that it is utterly impossible to mistake either of those two for the third; and as a convincing and easily recognised proof of what we state, our readers may compare ordinary "Magra Sand" with ordinary Ganges alluvion.

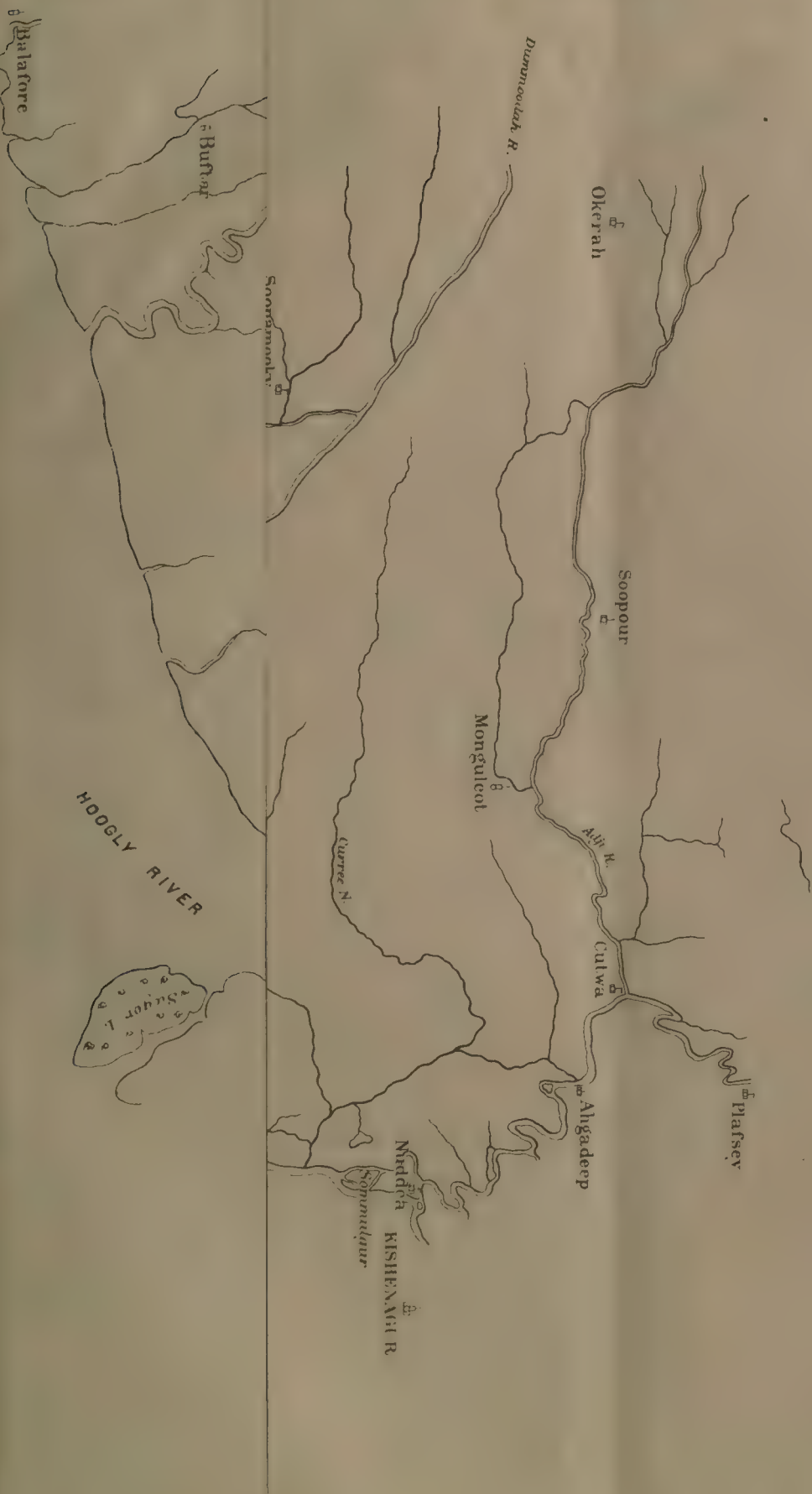
We have already established the fact of the Damuda having at one time (1750 A.D. and earlier conjecturally) flowed down the channel which empties itself into the Hooghly at Noaserai. This channel runs past the present E. I. Railway station of Magra, and for the last few miles of its course derives its name from this station, being known as Magra Khal. The Magra sand is dug out from the silted up banks of this stream.

This sand is, however, in all respects like the sand of the Damuda as it is found in that river anywhere above Burdwan and for a long distance below; a long way below the starting point of "old" Damuda at Salimabad, throughout its entire course in the administrative sub-division of Jahanabad and how much further we are not certain, as there is no stream except the Damuda which could have deposited these sands, and as we know that the Damuda did once flow down the channel, the conclusion is inevitable that it is the Damuda sands which we now dig up at Magra.

But what is not so well known is that close to Culna, near Guptipara sand of the same color and grain is also obtainable. Reasoning on the probabilities of the Damuda having once flowed down Rennell's "Bonka" we dug at and found not in small pockets as accidental deposits, but abundant and extensive layers of the sand. As there is no source except the Damuda by which these sands which we shall call the Culna (Kalna) deposit could reasonably have been brought and deposited there in the vast quantities that exist, we are compelled to conclude that the connection between the Damuda and Banka recorded by Rennell was no accidental cut, but that the Banka represents the course of the Damuda at a time so far removed, that when his maps and surveys were executed, a subsequent course of the great river had already had time to silt up and to be known as "old"



# TRACING OF THE PART OF MAJOR J. RENNELL'S MAP OF BENGAL.









Damuda, and even every traditional memory of the flow of the Damuda river down the Banka channel had wholly passed away. In short what appears to us the rational conclusion is that at some very remote period, perhaps from the time of the appearance of this part of the alluvial delta of Bengal above the high tides of the Bay of Bengal, this channel from Burdwan to Kalna known as the Banka was the channel of the Damuda; that at some period, still remote but comparatively later, this channel silting up, the river made its way down the Salimabad Noaserai Channel; and that finally, on the silting-up of this, the river took the course, it now flows in, entering the Hooghly a little above Hooghly Point and the James and Mary Sands.

When and why the two channels silted-up we shall try to discuss in a later part of the paper, as also the mutual influence which changes in the various courses of the Ganges, the Bhagirathi and the Damuda may have had on each other; we are now concerned with the illustration.

(To be continued.)

## EXTRACTS FROM AN ENGINEER'S NOTE-BOOK. XL.

Painting wood-work, new, 3 coats.

Items per 100 s. ft. (1.)	No. or Quantity. (2.)	Rate. (3.)	Amount. (4.)	Total. (5.)	
<i>Labor.—</i>					
Painters                      No. ...	2.2	Variable			
Cooly                                „ ...	$\frac{1}{2}$				
<i>Materials.—</i>					
Prepared Charlton Paint                      lbs. ...	6.5		Do.	Do.	
Boiled Linseed Oil gals.	0.17				
Sundries,                      Whiting, Brush, Scaffolding, &c.	...	...	...		
Petty Establishment ...	...	...	...		

*Note.*—1 drum of 5 gallons contains 44lbs. of linseed oil. 1 gallon = 8.8lbs. =  $6\frac{1}{2}$  to  $6\frac{3}{4}$  ordinary quart bottles.

Each coat takes paint and oil in the following proportions:—

1st coat ...	2.3 lbs. paint,	0.5 lb. (= .06 gal.) oil.
2nd " ...	2.1 " "	0.415 " (= .055 " ) "
3rd " ...	2.1 " "	0.415 " (= .055 " ) "
Total ...	6.5	1.33 lb. (= 0.17 gal.) oil.

For repainting old work, add 2 coolies to the detail of labor, for thoroughly scraping off old paint.

For painting iron-work with 2 coats the labor will be two-thirds of that detailed for three coats of paint to wood-work, and the material used will be 13lbs. of dry red lead and .28 gallons of linseed oil.

**CONTINUOUS BRAKES.**—During the year ended 30th June last, the automatic vacuum brake appears to have been the one most in favour with the railway companies of the United Kingdom, as may be judged from the fact that the number of engines fitted with it rose from 2,581 in 1887 to 3,588 in 1888, whilst the number of carriages, &c., to which it was applied, increased from 13,883 in 1887 to 17,750 in 1888. The Westinghouse automatic brake was in use on 1,804 engines, and 14,652 carriages, &c., on 30th June, 1887, and on 1,915 engines, and 14,836 carriages, &c., on the same date in 1888. Of the 679 brake failures reported during the half-year ended June 30th last, 246 were of the automatic vacuum brake, and 327 of the Westinghouse automatic, the failures of the latter consisting mainly of bursting of the hose pipes. The number of miles run by trains fitted with continuous brakes of all kinds was 66,053,727, of which 33 per cent. were run with the automatic vacuum brake, and 27 per cent. with the Westinghouse automatic.

## Official Papers.

### INDIAN MEDICAL SERVICE.

*Rates of Pension from 1st January 1881.*

After 17 years' service ...	£ 292 per annum
" 20 " " ...	" 365 "
" 25 " " ...	" 500 "
" 30 " " ...	" 700 "

2. In addition to the above pensions for length of service the following are granted:—

*Surgeon-General.*—After 5 years' active employment as such, inclusive of 6 months' leave on medical certificate or 4 months on private affairs ... £ 350 per annum.

*Deputy Surgeon-General.*—After 5 years' active employment as such, inclusive of 6 months' leave on medical certificate or 4 months on private affairs ... £ 250 "

3. The periods of leave allowed to reckon as service for pension for officers serving under the rules of 1854 or 1868 are:—

2 years in 17 years' service.
3 " 20 " "
4 " 25 " "
5 " 30 " "

Officers under the rules of 1796 or 1875 count service as noted above in paragraph 7.

4. A Surgeon-General or Deputy Surgeon-General who has completed his tour of service and has reverted to British pay, may at once proceed to and reside in England and qualify for a higher pension.

## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

Burma, November 17, 1888.

The following transfers have been ordered:—

Mr. C. E. Housden, Executive Engineer, 4th grade, from the II. to III. Circle for the charge of the Kyaukse Division.

Mr. H. O. Walling, Assistant Engineer, 1st grade, from the III. Circle Mandalay Garrison Division, to the II. Circle, Chindwin Division.

Mr. H. W. James, Assistant Engineer, 1st grade, Meiktila Division, has passed in Burmese by the departmental standard.

Bengal, November 18, 1888.

Mr. F. J. Pope, Assistant Engineer, 1st grade, is transferred from the Western Bengal Railway Surveys to the Eastern Bengal State Railway.

Mr. C. E. C. Montresor, Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India an extension of ten months' furlough, in continuation of the furlough granted to him in this Department Notification of the 22nd March 1888.

With reference to Government of India, Public Works Department Notification of the 21st November 1888, Mr. E. J. Keelan, Executive Engineer, 2nd grade, sub. *pro tem.*, is posted to the Tirhoot State Railway.

Madras, November 20, 1888.

The following reversion and promotions are made:—

Mr. H. E. G. Evans Executive Engineer, 4th grade, sub. *pro tem.*, to Assistant Engineer, 1st grade, permanent rank, with effect from 19th September, 1888.

Mr. A. A. G. Malet, Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 19th September 1888.

Mr. J. D. Grant, Executive Engineer, 1st grade, sub. *pro tem.*, to Executive Engineer, 1st grade, permanent rank with effect from 12th October 1888.

Captain L. Langley, R. E. Executive Engineer, 2nd grade, sub. *pro tem.*, to Executive Engineer, 2nd grade, permanent rank, with effect from 12th October, 1888.

Mr. H. S. Taylor, Executive Engineer, 3rd grade, sub. *pro tem.*, to Executive Engineer 3rd grade, permanent rank, with effect from 12th October 1888.

Mr. A. S. Russell, Executive Engineer, 3rd grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, permanent rank, with effect from 12th October 1888.

Mr. G. P. Carless, Executive Engineer, 4th grade, temporary rank, to Executive Engineer, 4th grade, permanent rank, with effect from 12th October 1888.

Mr. J. S. Wilson, Assistant Engineer, 1st grade, sub. *pro tem.*, to Assistant Engineer, 1st grade, permanent rank, with effect from 12th October 1888.

M. R. Ry. R. A. Srinivasa Aiyangar Avargal, Rai Sahib, B.A. B.C.E. Assistant Engineer, 1st grade, sub. *pro tem.*, to Assistant Engineer 1st grade, permanent rank, with effect from 12th October 1888.



Mr. W. Hughes, B.A., Executive Engineer and Superintending Engineer, 3rd Class, 2nd grade, temporary rank, to Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 12th October 1888.

Mr. W. B. De Winton, Executive Engineer, 3rd grade, sub. *pro tem.*, to Executive Engineer, 2nd grade, with effect, from 12th October 1888.

Mr. C. H. B. Burlton, Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, with effect from 12th October 1888.

Mr. A. B. Todd, Executive Engineer, 4th grade, sub. *pro tem.*, to Executive Engineer, 3rd grade, with effect from 12th October 1888.

Captain W. D. Lindley, R.E., Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 12th October 1888.

The following reversions are ordered :—

Mr. W. Hughes, B.A., Superintending Engineer, 3rd class, temporary rank, to revert to Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 7th November 1888.

Captain W. D. Lindley, R.E., Executive Engineer, 4th grade, temporary rank to revert to Assistant Engineer, 1st grade, with effect from 7th November 1888.

Mr. W. Hughes, B.A., Executive Engineer, 1st grade, sub. *pro tem.*, will continue in charge of the VI. Circle until further orders.

The following intimation, received from the Secretary of State, is published :—

Mr. H. E. G. Evans, Assistant Engineer, 1st grade, Madras six months (s.o.) of extension.

Notification published in the *Fort St. George Gazette* of the 14th August 1888, posting Mr. J. D. Davies, Executive Engineer, 3rd grade, to the No. III Tank Party, Kurnool, is cancelled.

#### Bombay, November 22, 1888.

The Governor in Council is pleased to make the following appointments :—

Rao Bahadur K. R. Godbole, B.A., L.C.F., to be Executive Engineer, Kanara.

Mr. E. Pinhey to be Executive Engineer, Bijapur.

This cancels so much of Public Works Department Notifications dated 29th October and 3rd November 1888, respectively, as relates to the posting of these officers.

#### Punjab, November 22, 1888.

Mr. A. E. Orr, Assistant Engineer, 1st grade, was appointed to officiate as Executive Engineer and placed temporarily in charge of the Dera Ghazi Khan Provincial Division, in addition to his own duties, from the 21st September to the 5th October 1888, both days inclusive, *vice* Lieutenant MacLagan, R.E.

#### Irrigation Branch.

Colonel E. C. Garstin, Executive Engineer, Patiala Division, Sirhind Canal, is appointed to be in charge of the current duties of the office of Superintending Engineer, Sirhind Canal Circle, without retaining charge of his own office, during the absence on deputation to the Public Works Accounts Committee of Major S. L. Jacob, R.E., Officiating Superintending Engineer, Sirhind Canal Circle.

Mr. J. F. Farrant, Executive Engineer, 4th grade, temporary rank, is placed in Executive charge of the Patiala Division and the Canal Agency Office, Sirhind Canal, during the temporary transfer of Colonel E. C. Garstin, Executive Engineer, to the office of Superintending Engineer, Sirhind Canal Circle.

#### N.-W. P. and Oudh, 24, November, 1888.

#### Irrigation Branch.

His Honor the Lieutenant-Governor, North-Western Provinces, and Chief Commissioner, Oudh, is pleased to order the following promotion, with effect from the date specified :—

Mr. H. J. Strickland, Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Rai Pria Nath Ghose, Sahib, temporary Executive Engineer, 4th grade permanently transferred to State Railways, with effect from 8th November 1888.

With reference to Notification, dated 10th July 1888, transferring him, as a temporary measure, from the Bhognipur to the Cawnpore Division, Lower Ganges Canal, Mr. H. C. Sanders, Assistant Engineer, 1st grade, is retransferred to the Bhognipur Division, Lower Ganges Canal.

#### India, November 24, 1888.

Mr. E. J. Keelan, Executive Engineer, 2nd grade, sub. *pro tem.* State Railways, is transferred from the Establishment under the Director-General of Railways to that under the Government of Bengal.

Public Works Department Notification, dated 30th October 1888, transferring Mr. M. C. Mackinnon, Executive Engineer, 2nd grade, State Railways, from the Establishment under the Director-General of Railways to that under the Government of Bengal, is cancelled.

Mr. H. G. F. Smith, Executive Engineer, 3rd grade, sub. *pro tem.*, State Railways, is transferred from the Establishment under the Government of Bengal to Madras, for employment on Railways in that Presidency.

Mr. H. T. Geoghegan, Superintending Engineer, 1st class, State Railways, is granted special leave for two years under the terms of Public Works Department letter, dated 3rd October 1887, with effect from the date of expiry of the extraordinary leave on medical certificate granted to him in Public Works Department Notification, dated 9th May 1888.

#### Director-General of Railways.

Mr. C. J. Cole, Assistant Engineer, 1st grade, is granted furlough for twelve months, with effect from such date as he may be permitted to avail himself of the same.

#### Assam, November 24, 1888.

Mr. E. J. Mitchell, Assistant Engineer, 1st grade, is transferred from the Lower Assam to the Naga Hills Division.

Rao Sahib Matadin Sukul, M.A., Assistant Engineer, 3rd grade, who was transferred to Cachar and appointed to the officiate as District Engineer of that district in Orders dated 8th June 1888, made over charge of his duties to Rai Preonath Banerji, Bahadur, Executive Engineer, on the afternoon of the 10th November 1888, and reported his arrival at Sylhet on the afternoon of the 15th idem, to which division he was posted in Notification dated 16th July 1888.

## Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act V. of 1888, in the Office of the Secretary to the Government of India in the Revenue and Agricultural Department :—

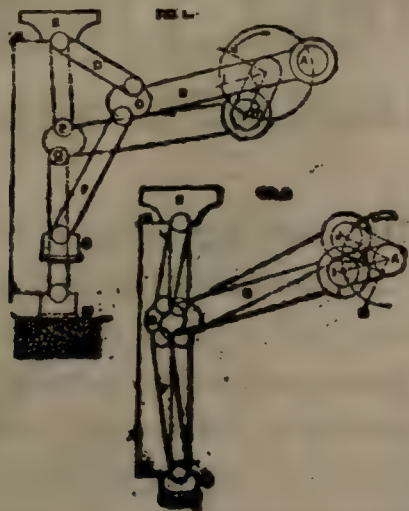
#### The 22nd November 1888.

- 192 of '84.—William Jackson, of Thorn Grove, Mannsfield, Aberdeen, Scotland, but late of 23, Beech Grove Terrace, Aberdeen aforesaid. Amended specification of his invention.—For improvements in apparatus for drying tea leaves and other materials.
- 196 of '87.—Edward William Serrell, Jr., Civil Engineer, of the City, County and State of New York, temporarily residing in Chabeuil, Department of the Drôme, France. Amended specification of his invention.—For an application of a solenoid for reinforcing electrical contacts.
- 37 of '88.—Thomas Toussaint Watson, Assistant Locomotive Superintendent, Great Indian Peninsula Railway, Jabalpur.—For pulling punkas by a machine to be driven by water or steam power, compressed air, electricity, vacuum or other motive power.
- 74 of '88.—The Lagerman Typotheter Justifier Company, Limited, of 35, Queen Victoria Street, in the city of London, England.—For apparatus for justifying printing formes.
- 75 of '88.—Luther George Chinnery and Swartz Martyn Chinnery, both of 14, Almack Road, Clapton, London, England, Engineers.—For improvements in gasogenes or apparatus for making aerated beverages.
- 78 of '88.—Elisha Gray, of Highland Park, Lake County, State of Illinois, United States of America, Professor of Physics.—For "Art of Telegraphy and Telautograph" apparatus.

#### RECENT BRITISH PATENTS.

BRICK MAKING MACHINES.—T. C. Fawcett & J. D. Fawcett, Leeds.—In Fawcett's Patent No. 4634 of 1887, a machine was described which consisted essentially of a system of toggle jointed levers; the arrangement was such that two pressures were applied to the brick in one revolution of the crank shaft. It has been found, however, that as the pressing plate did not descend any further in its second descent, the second beat did not materially affect the brick. In the present invention a knuckle joint is introduced into the mechanism, so that the two descents shall be unequal. Figs. 1 and 2 represent elevations of a set of toggle jointed levers and knuckle joint in different positions. The connecting rod B is attached to the driving crank A; at the other end of B is a knuckle joint C, which is made with two recesses, one receiving the end of the upper toggle lever D, and the lower receiving the end of the lower toggle lever E. The upper toggle lever is attached to a fixed part of the machine F, and the lower one carries the pressing plate G. In Fig. 1 the full lines represent the





toggles and pressing plate at their highest point, and the dotted lines indicate the position of the toggles when the pressing plate is imparting its first squeeze upon the brick M. The centres P Q of the levers in dotted lines are not directly over each other, but when the crank moves upward from H to I, the connecting rod will be carried further outward as shewn in full lines in Fig. 2; the pressure of the pressing plate will be removed from the brick during that motion, but as the crank continues its upward movement from I to J, the toggle levers will assume a straight line as shown in dotted lines in Fig. 2. The distance between the centres K and L in Fig. 2 will be greater than the distance N O as shewn in Fig. 1; therefore the pressing plate during the second movement will make a greater descent than during the first pressure. One claim is made for this combination of toggle levers and the knuckle joint for the purpose described.—No. 7305. May 17th, 1888.

## Advertisements.

D. P. W. India.

## IMPORTANT NOTICE.

All Civil Engineers of the Department are informed, that, owing to the extended support accorded to the Civil Engineers' Association, the Committee feel it necessary to still further widen their sphere of influence, and to delegate some of their duties.

The current work has been entrusted to Local Sub-committees, who will correspond with the Central Committee.

Every Civil Engineer is urged to write to the Hon. Sec. c/o Grindlay, Groom and Co., Bombay, who will put him in touch with his Sub-committee, with the view of enrolling him a member of the Civil Engineers' Association.

## SOUTHERN MAHRATTA RAILWAY.

LOCOMOTIVE Foreman wanted; Salary on probation Rs. 220, on confirmation Rs. 240, rising to Rs. 300; applications with copies of testimonials, which will not be returned, should be addressed to the undersigned,

C. P. WHITICOMBE,

*Loco. and Carr. Superintendent,*

HUBLI, 22nd Nov. 1888.

## BENGAL-NAGPUR RAILWAY.

### NOTICE.

WITH effect from 4th December this line of Railway will be opened as Broad Gauge from Nagpur to Raipur. For particulars as to rates and fares see published rate lists dated 3rd November which can be obtained at stations or from the undersigned.

By order,

J. W. HARTLEY,

*Traffic Superintendent.*

NAGPUR,  
Novr. 24, 1888. }

## WANTED

BY the Mozufferpur District Board 1 Overseer at Rs. 80 per month, and 3 Sub-Overseers at Rs. 35 per month exclusive of travelling allowances. None need apply who are not good surveyors and levellers.

Applications accompanied by copies of testimonials will be received by the undersigned up to noon on the 4th December 1888.

(Sd.) G. W. DISNEY, C. E.,

MOZUFFERPUR,  
November 23, 1888. } *District Engineer.*

## FOR SALE.

GIRDER Erecting Staging capable of erecting Girders up to 200 feet span. Also Portable Engines, Centrifugal Pumps, B. G. Rolling Stock, and other Engineering Plant.

For full particulars apply to—

MESSRS. GLOVER & CO.,

*Gwalior, C. I.*



**WANTED.**

**W**ANTED for the District and Municipal Boards of Hissar a **SECRETARY AND ENGINEER.** Pay Rs. 300 a month with travelling allowance when on tour.

Apply to

**DEPUTY COMMISSIONER,**

(205)

**HISSAR.**

**P. W. D., BENGAL.**

**AKRA BRICK FACTORY DIVISION.**

**W**ANTED twenty 2nd hand low-sided trucks, 5' 6" gauge.

Refer to Superintendent, Akra Brick Field, quoting price.

**S. C. GHOSE, RAI BAHADOOR,**

**SUPERINTENDENT,**

*Akra Brick Factory Division.*

**THOMSON & MYLNE'S****PATENT SUGARCANE MILLS.**

For particulars of Depots, Licensees, &c., address—

**THOMSON & MYLNE,**

**BEHEEA, E. I. RAILWAY;**

or 6, Commercial Buildings, Calcutta.

(103)

**CREAT WESTERN HOTEL,**

[29]

**BOMBAY.**

NOW READY.

**TO ENGINEERS AND ESTIMATORS.**

DIAGRAMS OF

Scantlings, Rolled Iron Beams, Water Velocities  
FOR ENGINEERS AND ESTIMATORS,

BY J. E. HILTON, MEM. INST. C.E.

A handy book with Litho-diagrams for estimating and designing rapidly.

*Cloth bound price Rs. 1-8*

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To be obtained of—

**W. BALL & Co., Govt. Printers and Publishers,  
LAHORE.**

**WANTED.**

**A** SITUATION as P. W. Inspector on construction or on an open line of Railway. The undersigned has had considerable experience in bridge and construction work; he has been on an open line for the past six years; his services are now being dispensed with owing to a reduction in the department.

Apply to—

**J. T. ROBINSON,**

**P. W. INSPECTOR,**

**KARCHANA,**

**(N. W. P.) E. I. Railway.**

(206)

**BEST MIRZAPUR STONE.**

The Mirzapur Stone and Trading Co., Cut-Stone Contractors and Quarrymen Murzapur, can supply—

Flagging ..	..	..	..	Roofing.
Pillar Bases ..	..	..	..	Coping.

And all descriptions of Cut-Stone. The cheapest in the market.  
Apply to the Company or to

**LYALL, MARSHALL & CO.,**

**4, Clive Ghat Street, CALCUTTA.**

Depot—Sulkea, Calcutta.

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# " THE NAHAN SUGARCANE MILLS."

These Mills have metal frames. The rollers are of close grain hard cast-iron, cast under pressure and have stood rough usage for years.

Every portion of the Mill is made to gauge so that should any part require renewing it is only necessary to send to the nearest Agency for it, where a duplicate can be procured with the certainty of its fitting.

It requires less power to drive than others.

At every Public Exhibition where the "NAHAN MILL" has been exhibited, it has extracted more juice than any other Mill.

For price lists and other information apply to the

**SUPERINTENDENT,**

**NAHAN FOUNDRY,**

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**NAHAN.**

**A GREAT WANT SUPPLIED.**

No Package Genuine  
without this Trade  
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Registered 14th October 1878.

**CYLINDER OIL.**

**TURNER, MORRISON & Co., Calcutta,**

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*Sole Agents for Bengal.*

## ROOMS WITH BOARD, BY DAY OR MONTH.

**Mrs. OGILVIE,**

**46, WELLESLEY STREET,  
CORNER OF PARK STREET,  
CALCUTTA.**

## E. T. C. BLEND HIGHLAND WHISKY.

Rs. 25 per dozen.

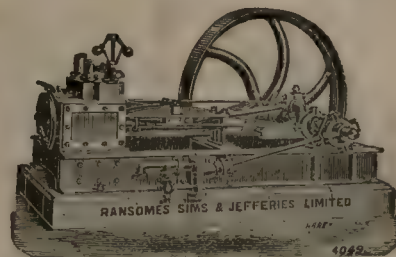
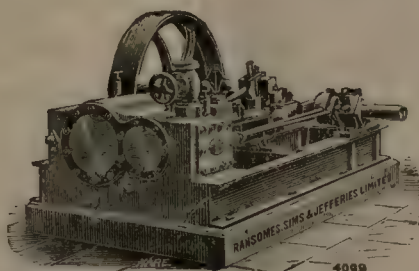
**GISBORNE & CO.,  
40, STRAND.**

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# RANSOMES, SIMS & JEFFERIES, LD., IPSWICH & LONDON.

ENGINES and BOILERS—Portable, Vertical, Semi-Fixed and Stationary.



Mining Machinery, Pumps, Saw Mills,  
Roller Flour Mills, Tea Rollers, and Sifters, &c.

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HARDWARE AND METAL MERCHANTS.

Stone's Patent Bronze.  
Babbitt's Metal and Richard's Plastic Metal.  
Regulus of Antimony, Pure Block Tin.  
Pig and Sheet Lead, Muntz Metal Rods and Sheets.  
Brass and Copper Rods, Tubes and Sheets.  
Zinc Sheets and Tin Plates.  
Best Tool and Miners' Steel.  
Spring Steel selected, and mild Steel Sheets.  
Lowmoor, Farnley, and best Staffordshire Bar and Sheet Iron.  
Plain, Galvanized, and Corrugated Iron Sheets, Ridging and Gutterings.  
Wrought Iron Tubes and Fittings for Gas and Water.  
Lap-Welded Boiler Tubes.  
Cast Iron Pipes with turned and bored spigot and socket joints and coated.  
Rain Water Pipes and Connections.  
High Conductivity Copper Tape Lightning Conductors.

(36)

*Rolled Iron Joists and Girders.*



These wheels are Noiseless and self-lubricating, do not drop off or allow the rope to be pulled off them, are easily fixed in any position, answer equally well as Vertical or Horizontal wheels, and run perfectly for years without attention.

Sole Agents for Madras :—  
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New and improved pattern, equally suitable for use in Churches, Hospitals and Public buildings as in Private Houses.

Calcutta Plumbing & Gas Fitting Establishment.



Materials of all sorts for the above always in stock. Trade supplied on the usual terms.

J. D. JONES,  
Mechanical Engineer,  
PROPRIETOR.

(108)



## BURRAKUR IRON WORKS, BURRAKUR, BENGAL.

Cast-iron Socket Pipes, of ordinary dimensions, coated with Dr. Angus Smith's solution, and tested up to a pressure of 250 feet of water	...	Rs. 4-4 per cwt.
Cast-iron Flange Pipes, of ordinary dimensions, tested up to a pressure of 250 feet of water, with faced joints and drilled bolt holes, coated with Dr. Angus Smith's solution	...	" 5-12 "
Cast-iron Bends, Tees and Cross Pieces for Pipings of ordinary dimensions coated with Dr. Angus Smith's solution from	...	" 7-0 " upwards.
Cast-iron Fire-bars, Floor-plates, Plain Columns, &c., from	...	" 5-0 " "
Cast-iron Railway Chairs and Railway Sleepers from	...	" 3-8 " "
Cast-iron Ornamental Columns, railings, gates, spiral staircases, porticos, brackets, arch-fillings, &c., in great variety	...	At cheapest rates.
Cast-iron Rammers, Road Rollers Garden Rollers, Sugarcane Rollers, Rain-water Pipes, Axle-boxes, parts of machinery and other castings of any description	...	At cheapest rates.
Water-lifts ... from Rs. 35-0 each, and upwards.	Foundry Pig Iron No. 1	" 45-0 per ton.
Ploughs ... Rs. 4-0 each.	Ditto No. 2	" 42-8 "
	Ditto No. 3	" 40-0 "

Remarks.—Special quotations for large orders. Designs of Ornamental Castings of any description can be had on application. Orders to be addressed to the SUPERINTENDENT from whom any further particulars can be ascertained.

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## THE INDIA RUBBER, GUTTA PERCHA, & TELEGRAPH WORKS Co., Ltd.,

ELECTRICIANS, ENGINEERS AND CONTRACTORS,  
MANUFACTURERS OF

### ELECTRIC LIGHT APPARATUS,

DYNAMOS LAMPS, CARBONS, LEADS, SWITCHES, VOLT AND AMPERE METERS. LEAD COVERED LEADS FOR UNDERGROUND WORK  
SUBMARINE TELEGRAPH CABLES AND WIRES,  
BATTERIES, INSTRUMENTS, AND TELEGRAPH CONSTRUCTION STORES, TORPEDO APPARATUS.  
PATENT LECLANCHE FIRING BATTERIES, FOR MINING AND BLASTING.

*Estimates given for all kinds of Electric Light Work.*

WORKS:—SILVERTOWN (ESSEX) AND PERSAN BEAUMONT (FRANCE.)

CALCUTTA BRANCH:—12, GOVERNMENT PLACE, EAST.  
GODOWNS:—DACRE'S LANE.

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Telegraphic Address—"SILVERGRAY," CALCUTTA.

## COMMERCIAL UNION ASSURANCE CO., LD.

*Extracts from the Twenty-sixth Annual Report viz. for the year 1887.*

FIRE DEPARTMENT.	LIFE DEPARTMENT.	MARINE DEPARTMENT.
Premiums after deducting	Premiums after deducting	Premiums after deducting
Re-insurances ... £769,265 0 0	Re-insurances ... £125,559 0 0	Re-insurances ... £175,118 0 0
Interest ... £19,612 0 0	Interest and Dividends ... £45,649 0 0	Interest ... £8,294 0 0
Losses after deducting Re-insurances ... £443,587 0 0	Claims less Re-insurances, £79,229 0 0	Losses after deducting Re-insurances ... £138,365 0 0
		Interest not belonging to above, but included in Profit and Loss ... £18,545 0 0

The Life Fund was increased during the year by £265,648 and now amounts to £1,070,064.

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the uncalled Capital of £2,250,000.

The rates of Premium are moderate, but they are not unsafely low, and will be found to stand the test of time, thereby in conjunction with the ample Funds affording absolute security to the assured.

The Total Funds and property in hand on 31st December 1887 stood at £2,613,059.

(39)

C. H. OGBOURNE, *Manager and Underwriter.*

## PURE HYDRAULIC LIME.

### FREE FROM ADULTERATION.

Numerous favourable certificates of the quality of our manufacture have been received, and the following are fair selections:—

J. H. APJOHN, Esq., Superintending Engineer, Kidderpore Dock Works, says:—

"Mr. McKennie's test for purity applied at Raneeunge shewed that it contained only 22 per cent. of insoluble matter, or only 3rds of the impurity allowed; there can be no question but that it is of very superior quality."

PAUL DEJOUX, Esq., Executive Engineer, Government Cement Experiment Division, reported:—

"It is the best Ghooting Lime imported into Calcutta."

JAMES KIMBER, Esq., M.I.C.E., Engineer to the Corporation of Calcutta, says:—

"It has been for long past and is now invariably used in all works, particularly drainage works. I have much pleasure in certifying to the excellent and reliable quality of the Lime."

O. A. MILLS, Esq., Executive Engineer, P. W. D., 2nd Calcutta Division, says:—

"The Ghooting Lime manufactured by Messrs. Burn & Co. is better than any that can be purchased in Calcutta. I have used it in the construction of many public buildings and have been thoroughly satisfied with it."

N.B.—Our Lime was used throughout all the River Works of the Calcutta Port Commissioners.

## BURN & CO.,

(179)

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Notices.

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NOTICE TO ADVERTISERS.

THE scope of this Journal makes it aspire to become the only thoroughly useful and trustworthy means of communication between the Profession and those who supply its wants. It should prove useful alike to users of machinery, engineering and building plant, or materials, and to the engineering trades generally, including manufacturers or importers in this country.

An object has therefore been to obtain for its columns special recognition as the best medium for ENGINEERING ADVERTISEMENTS in India. We use the word "India" advisedly since our circulation is not confined to any particular locality or province, but is pretty equally distributed all over the country.

It is hoped that the Profession will utilise the Journal more largely for making known its requirements, and the Editor's co-operation may always be relied on, should it be needed, for such purposes.

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Obituary.

BELL.—At Lanowli, on 27th November 1888, Wilson Bell, M.C.I.E., Chief Engineer, and Acting Agent, Great Indian Peninsula Railway,—aged 49 years.

INDIAN ENGINEERING.

SATURDAY, DECEMBER 8, 1888.

PROVINCIAL CONTRACTS.

THE familiar and we may say hackneyed passage from the bard of Scotland, about the well laid plan of man and mice often going 'agee,' finds an apt illustration in a recent document issued by the Government of Bengal on the working of the Provincial contract system inaugurated by the late Earl of Mayo. The primary object of the scheme was to allow local administrations to manage their own affairs, unhampered by the Supreme Government, so long as they did not exceed the tether allowed them. The balance of revenue after a settlement of income and expenditure was to be made over to the Imperial Government for Imperial purposes. Only in March 1887, there was a revision of the contracts for a term of five years, and the various administrations in the country felt assured that they were not to be pestered, at least during that period, with any more demand for scientific 'frontiers' or some such 'bogey' that disturbs the rest of our rulers. This immunity from further molestation, even at a sacrifice of a few lakhs, was acceded to, although reluctantly and accompanied by a little bickering. But in their innocence they had counted without their host, and their anticipations have been doomed to disappointment. Once more the bugbear of the continual falling rupee and the exigencies of Imperial interests require that a little more squeezing should be had recourse to. Before the ink with which the resolution referred to above was written had become dry, a Despatch from the Secretary of State burst like a shell over the heads of the administrators, and the little family arrangement arrived at a few months ago, was put out of gear to the great chagrin and disappointment of those who are required to make additional contributions to the public fund. It is the old, old story of the daughter of the horse leech crying for more blood. Its insatiable maw is never satisfied with what it gets. The Secretary of State writes imploringly to the Viceroy "to review the situation and to reconsider its relations to the Provincial Governments, and to seek an addition to its resources by modifying these relations, both in the direction of the further development of the principle of decentralisation, and in that of making the Provincial Governments bear a more direct share in the general financial burden." There is a little quiet humour underlying this passage which might suggest itself to the reader. Instead of boldly asking for more money, the Secretary of State indulges in a harmless joke and asks the Provincial Governments "to bear a more direct share," as if they have hitherto contributed their quota in an indirect and in a spasmodic manner.

The Secretary of State has awoke from a dream and suggests "that some system should be arranged by which the Government of India, as occasion demands, should announce to the Provincial Governments the extent to which in each case it had become necessary to modify the



normal arrangements, in order to meet the requirements of the Imperial Treasury, and the Provincial Government should reconsider and re-adjust their expenditure and revenue accordingly." We need not proceed any further, as the entire drift of the Despatch is directed to one end only, and that is the increase of contributions to the Imperial Treasury.

Before noticing the Resolution, we will, for a moment, refer to the Despatch in its bearing on the Public Works Department and the way it is disposed of. To be brief, the first principle to be recognised in this connection must be that all charges connected with roads and communications must be local. Thus, a distinction has been created between main Provincial lines of communication and local roads. Railways having now taken the place of the former for all practical purposes, they should now be classed among "General" expenditure; while roads would be classified under the head of "local" only, whether they serve a district or part of one, or in the wider sense of the interest in them, the advantage of them being confined within the area of one province. Buildings which are at present in charge of Local bodies, are charges in connection with what has been reckoned as expenditure of a local character; this will also include those exceptions which the Provincial Government has, for the sake of convenience, made over to Local Boards. The charge of some buildings used for what are classified as general purposes. The buildings which are at present charged to Provincial as distinguished from Local works, so far as they are utilised for hospitals, schools, and other local objects, are to be transferred to Local expenditure.

According to the Resolution of the Bengal Government, it was known in December last year that in the beginning of 1886-87 there was a credit balance of Rs. 14,70,000, and it was probable the revenue under all the heads, would, during the year, amount to Rs. 4,40,12,000; and that the total expenditure during the same period might not exceed Rs. 4,36,02,000, which would leave a credit balance of Rs. 18,80,000 at the close of the year. But the actual result has been more favorable than the foregoing estimate by Rs. 1,19,000. Among others, the expenditure of the Irrigation Department was short of the estimate by Rs. 1,63,000, while the receipts fell short of Rs. 8000 only. The Provincial share of the receipts under "Forests" is estimated at Rs. 3,65,000, against Rs. 3,50,000, under the head of "State Railway gross earnings," the receipts will be Rs. 1,15,37,000. The direct receipts from Irrigation Minor Works for 1888-89 has been fixed at Rs. 13,58,000, the same as the original estimate for 1887-88.

It is, however, supposed that the collections of water-rates on the Sone Canals will not reach the current demand, as the rate-payers have held back, under the impression that a large amount of dues will be struck off on the submission of the Report of the late Commission of Enquiry. The total receipts in 1887-88 will not have amounted to more than Rs. 11,03,000; the estimate for 1888-89 will be about 2 lakhs. Under the head "Expenditure,"

during the present year, the Forest Department will absorb Rs. 4,38,000, against Rs. 4,22,000 for 1887-88. With regard to Railways, the estimates have been increased from Rs. 70,000 to Rs. 93,000 to meet the cost of the survey of a line from Sarai Station, on the Tirhoot State Railway, to Somastipore, and of a line from Durbhunga to Somastipore. In the matter of expenditure under "Irrigation" the estimate under the head of "interest," will be reduced by Rs. 9,000. The estimate of the Government of India provides for a grant of Rs. 2,25,000 for the completion of the Orissa Coast Canal, but no grant has been made to the Provincial contract to meet this charge. The estimate of the work, which was taken into consideration at the time of the settlement of the late Provincial contract, was Rs. 41,16,201; a revised estimate of the work, amounting to Rs. 41,74,941, is under the consideration of the Public Works Department.

## THE NEW BURMA.

### I.

THE ideas entertained by the public about the course and conduct of affairs in Upper Burma, are almost entirely ideas connected with, or hinging on, conquest; the subjugation of a contumacious province, brushes with dacoits of a more or less Robin Hood reputation, new markets for British industries, the new Eldorado of the Ruby Mines, and so forth. Wherefore it happens that sundry good works done, a promising tale of progress effected in the cause of civilization, have been ignored. Little or no heed is paid to the useful practical work that has been carried on by non-militants, under manifold dangers and difficulties, in parallel lines with the march of conquest, and concomitantly with popular dreamings about Tom Tiddler's lands bubbling over with rubies, and inexhaustible markets for piecegoods, and Brummagen ware. It behoves us to remind this one-eyed lack of appreciation that Engineering has scored its triumphs in the new territory, as well as military rifles, and fighting policemen, and Mr. Streeter. More enduring triumphs than have fallen to their lot. Of the Railways and roads initiated in the new province, and of the employment afforded by them to thousands of shiftless men who, but for such aid, would probably have turned dacoits (or reverted to dacoitee) we have already written in previous issues. As to such matters, therefore, only a jogging of possibly short memories is needful here.

Turn we now to the less prominent, no less useful work done by survey parties. Between November 1886 and January 1887, Major Hobday accompanied expeditions to Thonze, Mainglon, Thibaw, and the Ruby Mines, and reconnoitered and mapped some 3,000 square miles of country. Lieutenant Jackson and his party completed another 3,000 miles of reconnaissance survey in different directions. Mr. Wyatt, with a small party, surveyed 2,000 miles in the Yamethin and Meiktila districts. Mr. Kitchin, with a Sub-Surveyor, surveyed 1,000 square miles in the Yaw country. Mr. Kennedy extended the triangulation from Mandalay north to Kyaunyat. Mr. Gibson has been carrying on a survey of the City of Mandalay, and the adjacent country.



Towards the end of 1886, Colonel Woodthorpe, and his assistant, Mr. Ogle, accompanied a military column which proceeded from Assam, *via* Manipur, into the Chindwin Valley. Triangulation was taken up from Manipur, and continued southward through the Kubo Valley to Chindwin, down which it was continued beyond Alon, until a junction with Major Hobday's series from Mandalay was effected.

Under the heading Public Works (Civil) we find Engineers busied with the planning and construction of combined Post and Telegraph Offices, of Law Courts for the head-quarters of districts; of a Government House at Mandalay of a residence for the Military Commandant there; of jails, bazars, dāk bungalows, and so forth. Six Sub-Divisional Court-houses at the cheap cost of about 3,700 rupees each have been built, and four more are under construction. Temporary Courts have also been built in many places. In March 1887 a Ward for 800 prisoners surrounded by a substantial stone wall was added to the Mandalay Jail. At the Myingyan Jail the outer wall of a prison for 1,000 people was completed. Several subsidiary buildings, such as cook-houses latrines, quarters for the guard and the jailor were in course of construction when the Report from which our facts and figures are derived was written, and the writer of the Report expected the jail to be ready to accommodate 1,000 prisoners by the end of September.

Buildings for housing 17,000 police and a hospital for them should be ready before that. Besides all this, an immense number of small stockades, capable of affording protection to from 25 to 100 men, have been scattered all over the face of the country. A store for the Indian Marine Officer has been built at Mandalay at a cost of Rs. 11,000. Offices have been constructed for Executive Engineers at nearly all divisional head-quarters at a cost of Rs. 1,000 each. What strikes us most about all these Public Works is their praiseworthy cheapness.

The nature of the country, its profuse rainfall, and liability to flooding does not admit of much cheapness in the way of road-making. Straining after cheapness in this instance would indeed be likely to lead to collapse, necessity to remake, and extra expense. The hill road (Ruby Mines Road) from Thabeikkyin to Bernardmyo, a distance of 60 miles, has been laid out, and the first 50 miles have been excavated from the hillside, and opened out for cart traffic, to a width of twelve feet. These 50 miles cost 3,00,000 rupees, the remaining ten miles cannot be proceeded with because of want of funds. The branch road to Mogok, striking off from the Ruby Mines road 13 miles from Bernardmyo, will be some 20 miles long, and will cost at least 1,00,000 rupees, unmetalled. An account is rendered of twelve lines of road, either constructed or in course of construction. There is nothing worth remarking on about them. The Mandalay Town Bund has been completed, at a cost of 4,38,000 rupees. It will be remembered that this bund was breached in 1886, in consequence of which the lower portion of the town was, in

some places, twenty feet under water. On inspection of the breached bund, it was thought advisable, in making a new one, to adopt a new alignment for nearly one-third its length. The work of repairs, amongst other works, necessitated bunds with puddle walls in them, 40 feet high, across two creeks 600 feet wide. In excavating for the foundation of the puddle wall, difficulties from water were experienced, but circumvented by means of sheet-piling and pumps.

About irrigation, it is stated that very little actual work has been done under the head—Irrigation—but endeavours have been made to discover what systems of irrigation are in working order, and how far others can be repaired by a small expenditure of money. Some information has been collected concerning the Kyauksè irrigation, which will, it is hoped, result in the weirs being thoroughly repaired in good time next cold season, and in the amount of water entering the head of the canals being regulated, so as to prevent breaches where there is excessive water in the river when in flood. In Shwebo, surveys have been made with a view to the restoration of the very extensive irrigation works in that district, which are now entirely out of repair.

The final grants of the year 1887-88 for civil and irrigation works were—

Civil works	...	Rs. ...	34,00,000
Irrigation	...	„ ...	2,00,000
Total			Rs. ... 36,00,000

In March a report was made to the Government of India that there would probably be a lapse of Rs. 2,00,000 under civil and irrigation works, and the civil works grant was consequently reduced to Rs. 32,00,000.

The actual expenditure taken from latest returns appears to be—

Civil works...	...	Rs. ...	33,41,000
Irrigation	...	„ ...	1,29,000
Total			Rs. ... 34,70,000

Important military works have been mainly confined to Mandalay, and include main drainage of the City and the eastern parts of Cantonments surface drainage of a portion of the land inside the City, and construction of barracks and subsidiary buildings for a Regiment of British Infantry, two Regiments of Native Infantry, Hospitals, Commissariat godowns, cattle sheds, and six miles of Cantonment roads. At Bhamo, two forts have been constructed and barracks for European and Native troops. Subsidiary buildings, Commissariat Offices and Officers' quarters, are now in course of erection. All these are to be permanencies. In addition to them a great number of temporary buildings for the accommodation of troops have been run up all over the Province partly by Military and Civil Officers, partly by the Public Works Department. All Military buildings, with the exception of those at the new post of Koni in the southern Shan plateau are now entrusted to the Public Works Department.



## Notes and Comments.

**MR. JAMES RAMSAY.**—This officer has taken over charge of the Western Bengal Railway Surveys, with Head-Quarters, *pro tem*, at Muddapur, E. I. R., chord line.

**TRAMWAYS AT MADRAS.**—The Government has authorised the construction of Tramways in Madras as arranged between the Municipality and the Indian Tramways Company.

**ERRATUM.**—In our leader on "Recent Girder Designs for India," which appeared on 24th November, the words "as better brace" should read "or batter brace"—*vide* page 401, para. 3, 19th line from top.

**MADRAS CANALS.**—There were on the 31st March last 1,564 miles of main canals and 4,269 miles of distributaries on the major irrigation works in Southern India serving 2,114,248 acres of land.

**MR. W. N. POGSON, F.S.A.**—The Government Directors of the Lawrence Asylum Press, Madras, have accepted the design under motto "*Caston*," by W. N. Pogson, F.S.A., submitted for their new buildings in competition.

**THE RUBY MINES CONCESSION.**—The concession for working the Burma Ruby Mines has been granted to Messrs. Streeter and Co., who will pay a rent of four lakhs annually to Government, besides one-sixth of the profits.

**BENGAL IRON.**—The exports of iron from Western Bengal to Calcutta rose from 3,947 maunds to 51,779 maunds within three months of this year, in consequence of larger operations by the State Iron Works at Barakar, which are situated within the above block.

**BENGAL-NAGPUR RAILWAY.**—The old metre gauge section of the Bengal-Nagpur Railway from Nagpur to Rajnandgaon was opened for broad gauge trains on the 27th November, and the extension to Raipur opened on the 4th December with quick through trains.

**INDO-EUROPEAN TELEGRAPH COMPANY.**—The Directors of the Indo-European Telegraph Company, Limited, have declared an interim dividend for the half-year ended the 30th June last at the rate of 5 per cent. per annum, free of income tax, payable on and after the 1st proximo.

**"ORDER OF THE RISING SUN."**—J. A. L. Waddell, Consulting Engineer of Kansas City, has had conferred upon him, by the Emperor of Japan, the "Order of the Rising Sun," with rank of Knight Commander, for "distinguished professional services rendered the Japanese Government."

**AN ADDITIONAL CIRCLE OF PUBLIC WORKS FOR BURMA.**—The Chief Commissioner of Burma has just arrived in Calcutta to meet the new Viceroy, and will, no doubt, while here, urge the importance as well as necessity for having an additional Circle of Public Works Superintendence for Upper Burma.

**ACCIDENT ON THE E. B. S. R.**—We learn that the up-mixed train from Calcutta to Damukdia met with an accident on the 4th instant near the hundredth mile. A buffalo derailed the engine and some vehicles. Nobody was hurt, but the line was blocked for some hours with a corresponding detention of the mails.

**ALLAHABAD WATER-SUPPLY.**—Nineteen members were present at the Municipal meeting when the report of the Sub-Committee on the water-works scheme was considered, leading to much discussion. The Chairman was of opinion

that fifteen lakhs would suffice, even if the head works were placed as high up the river as Baksi.

**BANGALORE WATER-SUPPLY.**—The question of the water-supply of Bangalore came up once again at the last monthly meeting of the Commissioners of that Municipality. It arose from General Fischer's criticism on Major Kensington's and Mr. Standish Lee's water schemes which appears to us to be as uncalled for as it was unnecessary.

**CANALS EXTENSION.**—The Right Honourable the Secretary of State has sanctioned the construction from Productive Public Works funds of the Punjab Extension of the Western Jumna Canal towards Sirsa. Direct Outlay, Rs. 28,92,687; Indirect Outlay, Rs. 1,89,857. The work will be commenced when funds can be made available.

**A WARNING!**—*The Madras Times* writes:—"If the lives of passengers per State Railways in India are to be intrusted to the tender care of Theorists, if the Viceroy (or others in his name), aim at becoming eventually Traffic Manager-General, then indeed we must convey the solemn warning to persons about to journey per State lines—*Don't*; or, if you *must* travel, take an Insurance ticket."

**ROHILKUND AND KUMAON RAILWAY.**—The report of the Directors of the Rohilkund and Kumaon Railway Company, Limited, for the half-year ended 30th June, shews a net profit of £4,150 at an exchange of 1s. 4½d. Adding sundry receipts and the balance brought forward, the total to be dealt with is £4,417, and the Board recommend a dividend of 2 per cent., free of English and Indian income-tax, for the half-year.

**MORE CHANGES.**—It is rumored that Colonel J. M. McNeill, R.E., is coming back to Bengal, and in that case (which seems to us to be very doubtful) Colonel Harrison and Major McArthur may be thrown back. It is pretty certain that Colonel Luard will not come to Bengal, and it is very probable that he may succeed Colonel Wallace in the Directorship of the N.-W. R., as the latter officer is said to be going home in February next.

**VILLUPURAM-DHARMAVARAM RAILWAY.**—Her Majesty's Secretary of State for India has sanctioned the construction, by the agency of the South Indian Railway Company, of a railway from Tirupati to Dharmavaram and from Pakal to Villupuram. This railway will in future be called the Villupuram-Dharmavaram Railway. The existing open line from Tirupati to Nellore will be known as the Nellore Branch of the above railway.

**BENIGHTED—VERILY?**—The Government have decided to reduce the salary of the President of the Madras Municipality. In future the salary will be Rs. 1,200 rising to Rs. 1,500. As regards the salary of the Vice-President, Public Works, the Government think the Commissioners will not be able to procure an efficient Engineer on Rs. 350 rising to Rs. 700. That the Commissioners should have thought otherwise is supremely ridiculous.

**SPECULATIONS.**—One of our correspondents writes:—"It appears certain that Colonel Luard will be out on 16th, and they do not know what to do with Colonel Le Messurier. It is possible, in case of Mr. Mallet going away, Colonel Le Messurier may fill his place. I hear that Mr. Rigby and Mr. Croudace, both over 50 years of age, are working out the furlough due to them on full pay in preference to taking it on half pay, having been offered the choice. Is this true?"

**BENGAL P. W. D.**—Owing to the return of Colonel J. P. Steel, R.E., Chief Engineer and Joint Secretary,



Buildings and Roads Branch, P. W. D., N.-W. P. and Oudh, Mr. T. H. Wickes, the acting incumbent, reverts to Bengal, as we have already announced, as Superintendent Engineer. Mr. Wickes will take over the Western Circle from Mr. H. Joll, who will relieve Mr. W. H. Nightingale of the Eastern Circle, the latter going back to his Inspectorship of Local Works at Bhagulpore.

**THE INSPECTOR-GENERAL OF IRRIGATION.**—Colonel R. Home, R.E., having been deputed to report on the Periyar Project, arrived at Thakady for that purpose on the 24th November. This visit is exercising some minds in Southern India, as it means something more than a mere *pro forma* inspection; and the question is, will he approve of the project as it is going on or will he not? It is rumored that the staff will go down to the plains at the end of February next, as at that time the dreadful fever-season commences.

**KIDDERPORE DOCKS.**—Government have sanctioned the Port Commissioners entering into a contract with Messrs. J. & H. Gwynne for the supply of pumping machinery for the Docks at a cost of £10,393; with Messrs. Westwood, Baillie & Co. for a supply of the iron-work for the bridge across the double entrance between the Tidal Basin and Dock No. 1, now under construction at Kidderpore; and with Messrs. Sir William Armstrong, Mitchell & Co., for the supply of the hydraulic machinery for swinging the bridge.

**AN ACKNOWLEDGMENT.**—We have received a copy of "A Bibliography of Indian Geology," being a list of books and papers relating to the Geology of British India and adjoining countries published previous to the end of 1887. It is compiled by Mr. R. D. Oldham, Deputy Superintendent of the Indian Geological Survey, and is issued as a publication of that Department. There can be no question of the utility of such a work for scientific research, and we must congratulate Mr. Oldham on his very complete and valuable catalogue.

**THE LAST OF THE OUDH AND ROHILKUND RAILWAY COMPANY.**—The first period of the contract with the Oudh and Rohilkund Railway Company being about to expire, it is notified that the State will assume charge of the line on the morning of the 1st January 1889. From the above date the Oudh and Rohilkund Railway will be removed from under the control of the Consulting Engineer for Guaranteed Railways, Lucknow, and will be placed under the Director-General of Railways. The head-quarters of the Railway will remain at Lucknow.

**THE VILLAPURAM-VELLORE RAILWAY.**—The works on the Villapuram-Vellore Railway are being vigorously pushed on. After the rains the rate of progress is expected to increase largely. The whole line should be ready, if the work from Vellore is pushed on, in 1889, its construction being carried out by the South India Railway Company, which will work the line after its completion and construct an extension from Vellore to Pakal, when a junction will be formed with Tirupati, and the Dharmavaram section with the Guntakul-Hindupur extension.

**INDIAN MIDLAND RAILWAY.**—The Indian Midland Railway line to Manikpore, on the East Indian Railway, is now finished up to the Ken bridge, about a mile beyond Banda. Trains run into Banda about twice a week with materials for the bridge. The Engineer of the branch hopes to have the line up to Banda open to the public

by the middle of January, but there is still a good deal of work to be done. Very few of the stations are built, ballast has to be laid down along the greater part of the line, and about half-a-dozen small bridges and waterways have to be put in.

**STATE RAILWAYS VERSUS COMPANIES.**—An interesting correspondence has been going on recently in the *London Times* on this subject, Sir Bradford Leslie adducing arguments in favor of the management of Railways by Companies rather than by the State. His conclusions are that it is unwise for the State to retain direct control of the Railways from an economical, as well as from a political point of view. He believes that "the direct State management of Railways is not profitable or desirable", and that "the commercial motive of dividend earning is the key to true efficient management."

**"PRACTICAL TRAINING" IN BURMA.**—The Burma Provincial Establishment is hardly suitable for the practical training of young Assistant Engineers, as very few masonry works are carried out in that Province. The only experience they require is simply in the construction of timber and bamboo structures. This must have been the experience of Mr. Tilly, formerly a Cooper's Hill Assistant Engineer, and now a Judicial officer, when he out of irony sent as an exhibit a standard plan of a Myoke's court-house to the Colonies Exhibition of London as a specimen of Engineering skill required in Burma.

**FLOATING PLANT, GODAVERI DELTA.**—The cost of the up-keep of the Godavari Delta Flotilla exceeds Rs. 20,000 per annum. The plant consists of steamers, dredges, barges, and iron and wooden flats with a host of minor craft, the original cost of which aggregated 5½ lakhs of rupees. The following rules for finding the present book-value of plant may prove of use to some of our readers employed on canal systems elsewhere:—(1) Boats and barges to be reduced 10 per cent. every year and the amount of special repairs, if any, to be added thereto. (2) Staff boats to be reduced by one-twelfth of their original cost for each year of their life.

**A WELL-FOUNDED COMPLAINT.**—The Local Fund Engineer of the Nilgiris, says that the tools used by him for District works have been chiefly obtained from the Mercantile Mission at Calicut; some rammers and crow-bars were purchased from the Public Works Stores at Madras, but the practice which prevails there of requiring full payment in advance, weeks and months before the articles paid for are delivered, is found very inconvenient, and the additional charge of 20 per cent. over Government prices makes rates prohibitively high. We have as much objection to *missionary* speculations of this class as we have against those of Government.

**MADRAS RAILWAY.**—The Consulting Engineer's Report for the half-year ended the 30th June 1888 shews that the average mileage open has been increased from 830 to 839 miles by the opening of the Calicut extension and the Palghat branch, the gross earnings exceed those of the corresponding period by nearly one lakh, the improvement being mainly due to the development of third-class traffic, to an increase under all other items of coaching traffic, and to the larger movement of troops. The working expenses are lower by nearly 1½ lakhs. The percentage of expenses to receipts is reduced to 58.39. The train mileage shews a small increase.

**EMPLOYMENT OF STEAM PUMPS IN THE MANUFACTURE OF SALT.**—The Madras Board of Revenue



have given the results of the working of the steam pumps employed by Messrs. Stuart, Hall and Co., at Karasa, and Messrs. Best and Co., at Manambadi, in connection with salt manufacture, but the experiments appear to have been made under very unfavorable conditions, owing to the extremely adverse nature of the season. The salt manufactured by Messrs. Stuart, Hall and Co. is reported to have cost 2 annas 2 pies per maund, and that by Messrs. Best and Co. 2 annas 1 pie per maund. The latter firm has since relinquished the lease of the Manambadi factory to Government.

"INDIA" P. W. D. NOTIFICATION, No. 293.—The following rule received the approval of the Secretary of State and was published for general information in the *Gazette of India*, 4th September 1888:—"No Chief Engineer of the Corps of Royal Engineers shall *without re-appointment* hold the same post for more than five years. This rule in the case of officers who, on their appointment to that rank received notice of the probable issue of this order, will take effect from the date they joined their present posts. In other cases the rule will take effect from the date of these orders." This rule is also applicable to officers of the Royal Engineers who hold the post of Secretary or Deputy-Secretary to the Government of India in the P. W. D.

IRRIGATION RESULTS IN SOUTHERN INDIA.—The gross receipts per acre irrigated in the Madras Presidency range from 1s. 5d. to 7s. 5d. on the Cauvery and Kistna delta systems respectively. The working expenses (excluding interest) per acre irrigated only come to one penny on the Cauvery system, whereas they attain 12s. 9d. on the Kurnool Canal. This latter work was purchased from the late Madras Irrigation and Canal Company. The result of taking over this work in 1882-83 was to reduce the percentage of net revenue on capital cost of irrigation works in Madras for which capital and revenue accounts are kept from 14.9, the average of the three years immediately preceding the transfer, to 5.4.

GOVERNMENT CONTRACTS.—The Government of India, having had under consideration certain cases in which agreements have been made with private persons or mercantile firms which have resulted in loss or inconvenience to the State, has prescribed rules for the guidance of Local Governments and Administrations—of which the following is the most important:—"In those cases where it is considered expedient to grant concessions or to make agreements which create any exclusive privilege, or impose any corresponding obligation upon the Government, the deed of concession or the agreement, if the rights under it are transferable, must be so framed that it will be beyond the power of the persons with whom the agreement is made to transfer their rights, or a part of them, without the sanction of the Government.

SILVER *VERSUS* EXCHANGE.—The *Englishman* calls for attention, and more than that may be, to the "curious" fact that the recent rise in silver has—so far—greatly exceeded the rise in exchange. It is only proper to give the *ipseissima verba*. Here they are:—"The price of the metal in London is now 44½d. per ounce, which makes the rupee intrinsically worth 1s. 4½d. The demand rate for sterling is, however, only a fraction over 1s. 4½d., which makes the rupee intrinsically worth 1s. 4½d. The demand rate for sterling is, however, only a fraction over 1s. 4½d., so that there is now an extraordinary divergence of nearly a half-penny between the price of silver and the rate of exchange." In whatever

form the homily comes its moral is, and in this generation must needs be, increase, fulfilment, adequacy, of export trade.

STATE RAILWAY EXTENSIONS.—Some 750 miles of line will shortly be, or have already been, opened as an addition to the Indian State Railway system. The details are as follows:—

Railway.	Sections.	Length. Miles.	Date of opening.
North-Western	... Ferozepore City Branch...	2	1st Oct. '88.
Mehsana-Vadnager	... Kheralee Extension ..	8	" " " "
Bengal-Nagpur	... Nagpur to Raipur ...	188	" " " "
Indian Midland	... Bhopal to Jhansi ...	190	1st Jan. '89.
Nizam's S. Ry.	... Banakalu to British Frontier	22½	" " " "
Bezwada Extension	... British Frontier to Bezwada	21½	15th Jan. '89.
Southern Mahratta	... Harihar to Berur ...	80	Jan. '89
Tirhoot S. Ry.	... Baptiali to Pertabgunge ..	14	1st Jan. '89.
Junagadh	... Junagadh to Verawal ...	50½	" " " "
Burma	... Pyinmana to Mandalay...	164	Probably Feby. '89.

FATAL RAILWAY ACCIDENT.—We have gleaned further particulars relative to the accident on the Tirhoot State Railway at Motihari on the 24th instant. When No. 21 up mixed train was coming into the station, instead of being run along the platform, it was, through some mistake at the points, diverted towards the goods shed. The morning was somewhat hazy; but when the driver observed that he was on the wrong line, he whistled and applied the brakes. The goods shed is only a short distance from the points, and the train ran into some wagons which were being loaded at the shed. Three natives employed in loading were killed outright, several others escaping with slight injuries. Four wagons were completely destroyed, and about four others and the engine were more or less damaged. The pointsman, who was absent from his post, is in custody.

NON-METALLIC MINERALS IN MYSORE.—Mr. Bruce Foote had a very poor opinion of these when he carried on his auriferous inspection of the province between February and May of 1887. Emery, Asbestos, Felspar and Kaolin were not abundant in any part. But good marble and grey crystalline limestone were noticed by him in certain localities. The latter are several hundred feet thick and deserve to be prospected. Fine granite, eminently fitted for cutting and polishing, is abundant in parts. But porphyry pleased Mr. Bruce Foote best. He thinks that the beautiful porphyry on the hills east of the Karigetta temple overlooking Seringapatam would take a very high polish and for decorative purposes of high class, such as vases, panels and vases, for busts and tazzas, &c., it is unequalled in Southern India. If well polished it fully equals many of the high prized antique porphyries. But the question in this and other matters is the forthcoming of the necessary capital to work the dykes.

THE O. AND R. STATE RAILWAY STAFF.—The Governor-General in Council is pleased to make the following appointments to the Oudh and Rohilkund Railway, with effect from the 1st January, 1889:—Major R. A. Sargeant, R.E., Superior Revenue Establishment of State Railways, class 1, grade I, temporary rank, to be Manager; Mr. F. T. G. Walton, C.I.E., Resident Engineer, Oudh and Rohilkund Railway, to be Engineer-in-Chief; Mr. G. Winmill, Superior Revenue Establishment of State Railways, class II., to be Locomotive Superintendent; Mr. S. C. E. Hartwell, Agent and Traffic Manager, Oudh and Rohilkhand Railway, to be Traffic Superintendent; Mr. J. Lightfoot, Manager, North-



Western Railway, Sind Section, class I., grade 2, Superior Revenue Establishment of State Railways, to be Auditor; Mr. E. T. Anthony, Accountant, 1st grade, and Honorary Assistant Examiner of Accounts, to be Store-keeper. The Government of India is also pleased from the above date to make the following additional appointments to the Oudh and Rohilkund Railway from the officers of the Oudh and Rohilkund Railway Company who have accepted service under Government:—Engineering Department—Mr. C. L. Sim, Mr. W. Rogers, Babu Ram Gopal. Traffic Department—Mr. A. Muirhead. Locomotive Department—Mr. C. S. Moore.

**A USELESS GOVERNMENT DEPARTMENT.**—Is it not high time, more than high time, that the fudge, the fretful vaingloriousness, the utter inutility of what our Rulers and Governors are pleased to miscall an Agricultural Department, should be a reproach wiped off from the tale of discomfiture attaching to latter day philanthropy in India? Existence of the Department involves an appreciable mulct on the incomes of Indian tax-payers. It is of no slightest use to them. They know better than any European bred in Devonshire or the Shetland islands possibly could, what crops, what rotations of crop best suit the exigencies of the soil they have been born in, and wedded to. It is worse than idle to try for supplementation, supplantment, of their endeavours by means of dogmatic, only half proved and assured rules. The *Pioneer* of the 24th September, *d'propos* of our subject, writes with reference to the Etcetera Department:—"To judge by the candid disclosures of the shortcomings of this Department, the Bengal Government must be tiring of its bantling. The Department *appears to have no duties, other than those of supervising survey and settlement.*" The italics are ours. It only remains to ask what is the departmental, adequately diplomatic meaning attached to the word "department?" What can be the possible use of such a *lusus nature*?

**DEATH OF MR. WILSON BELL.**—Since our last we have learned further particulars relative to the career of Mr. Wilson Bell, the much respected acting Agent and Chief Engineer of the G. I. P. Railway Company, which occurred early yesterday morning at Khandalla. The deceased gentleman, who was well known in Bombay and throughout the various districts traversed by the Railway had, since his arrival in this country in the year 1864, by his Engineering knowledge and general management of his department, done much to increase the revenue and general stability of the Railway. On his arrival Mr. Bell was appointed Assistant Engineer, and in that capacity saw much of the earlier extensions of the Railway planned and carried out. He remained in this position for some time and was afterwards promoted to Resident Engineer and District Engineer. In 1874 he became Chief Engineer of the Company, which position he held until the time of his death. In 1878, during the absence on leave of Mr. G. A. Barnett, the Agent of the Company, Mr. Wilson Bell acted as Agent, and during his term of office shewed great aptitude for the duties. About the month of May 1886, the deceased proceeded to England on six months' sick leave, and owing to the nature of his illness, he obtained two further extensions of a like period. Returning to India in 1887 after his 18 months' absence, Mr. Bell again acted for the Agent, and continued doing so up to the time of his demise: He was only 48 years of age.

**HOW THE MONEY GOES!**—There is no one so blind as he who *will* not see. The facts and arguments we placed before Sir Charles Elliot on the subject of subsidising our rival were so cogent, that none but a man with hardened prejudices would have disregarded them. Subsequent events have proved that our surmises were quite correct. In fact, his position was so untenable, that thinking discretion the better part of valor he did not deign to send us a reply. And as the amount of the subsidy had to come, not from his pocket, but from those of poor dumb rate-payers, it did not need an inelastic conscience to will it away. How far our predictions, that the paper he so generously supported at other people's expense, was being carried on at a dead loss ever since it was created, have been realised, will be proved from the evidence of a disinterested witness who had no object in distorting facts, but simply gives to the commercial world the financial position of our rival. We refer to the Calcutta commercial correspondent of the *Pioneer*, whose letter in the issue of that paper of November 13, shows the true state of affairs on the 30th, June last—*viz.*, that Messrs. W. Newman and Company, Limited, "have dropped a very considerable sum of money on their newspaper venture." Let us add that the total loss up to the date mentioned is Rs. 30,000! *Capital* also gives further particulars on this head in its issue of the same date. Thus it may be seen how public money goes in India under an irresponsible Government, and when our native fellow-subjects raise their voice against such wilful waste of money squeezed out of the bones and muscles of ratepayers, they are cried down as Seditious!!

**LADY DUFFERIN ZENANA HOSPITAL, CALCUTTA.**—The foundation-stone of this building was laid last Wednesday afternoon in the presence of a large and representative gathering of European and native ladies and gentlemen. The proceedings began with the reading of the Report of the Bengal Branch of the National Association for Supplying Female Medical Aid to the Women of India by Mr. H. J. S. Cotton, the Honorary Secretary. His Honor the Lieutenant-Governor then addressed Their Excellencies the Marquis and Marchioness of Dufferin, and alluded in appropriate terms to the excellent services of Mr. Girling, the Honorary Assistant Engineer, in arranging for the ceremony. Her Excellency the Marchioness then proceeded to lay the stone and was accompanied down into the trench by Lady Bayley. The Honourable Mr. Hutchins asked Lady Dufferin's acceptance of the gold trowel which had been magnanimously presented by the Sheriff of Madras (mark! not by a Croesus in the City of Palaces) Mr. Girling supervised the details. After Her Excellency had smoothed the cement and the bottle with the usual contents had been deposited in the hollow the upper stone was lowered on its bed, and having applied the square and tapped the upper stone with a mallet Her Excellency declared that the stone was truly and properly laid. His Excellency the Viceroy then spoke a few well-chosen words, after which Raja Peary Mohun Mukerjee and Nawab Abdul Latif Khan Bahadur, returned thanks for the honor that was felt by all present at the interest Their Excellencies took in the Zenana Hospital for Calcutta. The stone was patent stone made by Mr. Garlick. A view of the proposed institution, as seen from the new Central Road, drawn by Mr. Gwyther, was on view: it is evidently intended that the whole design will bear an Oriental character and form no unimportant feature on that future thoroughfare.



## Current News.

THE India Office has called for a report on the oil-wells of Burma.

COLONEL CONWAY-GORDON, Director-General of Railways, arrived in town by the mail train on Tuesday morning.

THE Officiating Meteorological Reporter to the Government of India, Mr. J. Eliot, has left Calcutta on tour.

IN Siam the march of improvement has reached a stage admitting of the formation of a Siamese Insurance Company.

DR. K. McLEOD has been appointed President of the Calcutta Health Society, *vice* Mr. Justice Cunningham, retired.

PAHANG in the Malay Peninsula continues to arouse attention in the way of developing its extensive natural resources.

SIR ALBERT CAPPELL obtains 15 months' extension of furlough and then retires from the service, as we announced some time ago.

TRAMWAYS have proved so decided a success at Manila that the company working the lines has decided upon introducing steam motors.

THE Photographic Society of India's Exhibition will take place again this cold weather in Calcutta. It will be open to India, Burma, and Ceylon.

THE first petroleum well in the Punjab will be sunk in a few days by the Syndicate to whom concessions have been granted at Fatehgarh, near Rawalpindi.

JUTE to the value of two lakhs of rupees was destroyed by the late fire at the Ganges Jute Mill in Calcutta. Another fire has since been reported at the same Mill.

PLANS and estimates of the long-needed European General Hospital, Bombay, are being prepared by Mr. Adams, Architectural Executive Engineer to the Government.

ON return from field service Captain H. F. Chesney, R.E., is transferred from the Lahore Division, Military Works, to the Barrackpore Division, Military Works.

ON being relieved by Captain Chesney, Lieutenant-Colonel G. D'A. Jackson, General List Cavalry, is transferred from the Barrackpore Division, Military Works, to the 2nd Pishin Division.

MESSRS. MASSAY & Co. have obtained the contract for the through overhauling of the bracings and other iron frame works of the Madras Pier. The entire planking and wood work has been completed.

THE Bengal Government has purchased on the Continent some of the most improved silk-worm apparatus for use in connection with the silk-rearing experiments now being conducted in Berhampore and elsewhere.

THE efforts of the members of the Branch Indian Association, Rohora, in connection with the lighting of the carriages of the E. B. S. Railway have borne fruit. The Railway authorities are now supplying lights in the carriages.

NATIVE commissioned officers are to be admitted into the Native Military Survey Class at Roorkee in future, but the number per class will be restricted to two, and they will join as pupils under the same conditions as other native soldiers.

COLONEL CROWDY, R.E., Superintending Engineer of Military Works in the Meerut Command, has been placed on special duty here to devise a scheme for the prevention of any further encroachments of Delhi City proper towards the Fort.

COLONEL STEEL, R.E., Joint Secretary in the Public Works Department to the Government of the North-West Provinces and Oudh, was expected at Allahabad on Tuesday last from England to take over charge from the officiating incumbent, Mr. T. H. Wickes, who returns to Calcutta.

THE Commissioner of Sind strongly advocates the construction of a small local line from Hyderabad to Midpur. Mr. Horace Bell also advocates the construction of this small line on the broad gauge as a valuable feeder to the North-Western Railway and the Great Western now being surveyed.

THE goods traffic of the Manihari-Kasba section of the Assam-Bihar State Railway has increased by leaps and bounds, and the existing rolling-stock has been found to be quite insufficient to

cope with it. This short length of line has, in the course of a year-and-a-half, paid extraordinarily well.

MR. E. J. KEELAN, Executive Engineer, has been placed in charge of the Sitamari extension of the Tirhoot State Railway. The preliminary survey will be taken up at once. Mr. E. J. Martin, Chief Engineer, Public Works Department, Bengal, visited Mozufferpore to devise plans for starting relief works in connection with the extension.

BUILDING appears to be pushed on during the winter season with great energy in Simla; the Roman Catholic Cathedral has almost arrived at that stage when its roof can be put on; the Town Hall has its warranted waterproof iron roof half on; and the United Service Club are building a tea-room on a site which at present appears more suitable for the vagaries of the chamois than for any solid foundation.

As the Jhansi-Manickpur section of the Indian Midland Railway is, with the exception of the Dassan and Ken bridges, practically complete, the Kirwi, Banda and Mau Divisions have been broken up, and the whole length placed under Mr. Glover, late District Engineer of the Mau Division, with head-quarters at Banda. Messrs. Dallas and Benedict, the District Engineers of the Kirwi and Banda Divisions, have left the line on the expiration of their agreements, and Messrs. Edwards and Scott, Assistant Engineers, leave during the present month.

## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

### "PRIVATE AND CONFIDENTIAL."

SIR,—I was not a little amused at the flimsy trick attempted by your rival in his last issue, to throw discredit on you and the Circular issued in the name of the C. E. D. Association. The device is so palpable—the letter and the foot-note being the product of the same disingenuous brain—that I wonder the writer did not see through it himself. Amateur journalism is ashamed to hide itself under a bushel, but must needs proclaim itself from housetops to make its shortcomings more prominent. This silly attempt to stab one's reputation in the dark is quite in keeping with the antecedents of that paper. Every impartial reader of INDIAN ENGINEERING will have observed the straightforward and upright way in which you conducted yourself in the correspondence anent the subsidy. Relying on the justice of your cause and having the courage of your convictions, you gave publicity to your entire correspondence with the Viceroy, Public Works Minister, &c., instead of going to work in a nook and corner manner, so much to be deprecated by men of independent feelings. The gross injustice done to you by propping up a tottering venture, is a by-word among the Profession, but you need not despair. Time alone shall prove that right is might. Has your contemporary exercised the same discretion and straightforwardness which he preaches now and published the appeal it made to Government for help, which you properly characterised as a tissue of misrepresentations? As your contemporary harps on the word 'English'—whether he has a right to do so is an open question—I would, with your leave, ask whether it may be applied to him or to you, who maintain an independent position without being thwarted by fear of those in authority, in addition to the respect and regard you have secured of the Profession by bold and open action.

"Fair play" is your motto, but you have not succeeded in getting it at the hands of the Government, though the Profession has rallied round you right gallantly. You asked that the two journals might be left to fight their own battle for public favor. Even this was refused to you, and in an evil hour and in an unseemly manner, the Supreme Government interfered at the instance of wire-pullers. You are willing to leave the issue in the hands of the Profession which both journals profess to serve, and by their verdict you shall stand or fall, on your merits or demerits. It is worse than useless mincing matters at this stage when your contemporary, like a drowning man, clutches at a straw. He cannot afford to be independent, having sold his birthright for a mess of pottage, but is under the immediate control of a firm of shop-keepers, which has, according to our childhood's ideas, to be correspondingly "meek and mild" and a supplicant for general favor.

ANTI-HUMBUG.

[Our Correspondent makes no allusion to the misleading circulars of the firm, one of which was sent to us by a Superintending Engineer in the P. W. D. with an expression of opinion condemnatory of the principles that dictated it. That opinion was echoed far and wide. As regards the mis-statements made in the firm's appeal to Government for help, we have only to observe that we have not done with them yet; but there can be no doubt that it was our sympathy with the grievances of the C. E.'s. of the P. W. D., openly evinced by us, that mainly contributed to the *ex parte* decision of Government against us.—ED., I. E.]



## PROMOTION IN THE P. W. D.

SIR,—The recent Circulars 2535 G. of 1st October and 2591 G. of 6th October indicate at least on appreciation on the part of the Government of India, that the promotions in the P. W. D. have not always been managed in the best possible manner; and credit must be given for an attempt to make the best of a very difficult matter.

Merit of course should be the sole and only claim to promotion, but then the difficulty immediately occurs; what is merit?

Scoffers say that to have a pretty or useful wife, or to be useful yourself in any way out of your profession, especially at Simla, or to be connected there, is the greatest merit, but to such base insinuations I pay no heed.

It was, I believe, Lord Palmerston who defined the best man for a post, as "the man I know best," and indeed this maxim may be logically defended, on the ground that the nominator may be certain that his nominee will do credit to his selection, whereas there may be others equally capable, but of whom he cannot be as certain, because he does not know them so well.

It may also be said that a really able man must have the faculty of selecting the best from among the men under him.

All this is consistent with the assumption of the most perfect impartiality, but now the personal equation must be taken into consideration. Excluding some men whose likes and dislikes are so pronounced that their verdict would be received with caution, how few even among the most judicially minded can be found, who would be insensible to the judicious administration of the more subtle forms of what we may, for want of a more accurate word, call flattery?

Are there many who would prefer the subordinate who steadily upholds his opinion as differing from his chief, while honestly carrying out his orders, to another who with less firmness or more of this world's wisdom, apparently allows himself to be convinced by the chief's superior wisdom, though in fact still disapproving of the measure in question?

My experience of the *genus homo* species Indian official leads me to the belief that as a rule their motto is "*sic volo sic jubeo*," and that they are impatient beyond the average man of a difference of opinion in their subordinates; a frame of mind much to be deprecated in a scientific department like the P. W. D.

Luck again has much to do with promotion, merit being equal, under any rule except absolute seniority. For example, A has the good fortune out of all the alphabet to fall into a place where he has the chance of shewing what he can do, and thereby obtains a name and promotion, while perhaps there were other six of the letters equally capable, but who had not the luck to get the opportunity of distinguishing themselves.

Still, as no human affairs can be perfect, I am disposed to welcome the principles laid down as the best that can be adopted, and I hope never to see the recurrence of such imbecilities as sending locomotive Engineers to survey for canals, and continuing to promote men who are perfectly useless, nay mischievous, simply because they continue to exist, while neglecting others of undoubted usefulness, simply because it is not the rule to promote them yet.

I would even suggest the advisability of a further application of the principle of merit in reducing the redundant strength of the P. W. D. by getting rid of bad bargains; only if this be attempted it must be honestly carried out right through, remembering that the more years an idle or incompetent man has drawn his pay, the greater the injury he has inflicted upon the Department, and the more urgent the need to get rid of him.

STANLEY ENGINEER.

## DIVERSIONS ROUND CULVERTS.

SIR,—The following "Rider" on Mr. Campbell's "Prop" given on page 376 of INDIAN ENGINEERING of 10th November may be useful.

A practical point which is not considered in the article in question is, that it is usually desirable, in order to economise earthwork, to let the diversion run down on to original ground-level and up on the other side: this dip to have a certain limiting gradient on both sides.

Let  $l$  in  $x$  be this gradient and let  $h$  be the height of the culvert: then if the main line is level we get a very simple formula for  $cG$  and  $cG^1$ .

$$cG = cG^1 = h \cdot x - L \dots \dots \dots (3)$$

the value of  $L$  being the same as found by Mr. Campbell in (1).

Now suppose the main line has a falling gradient of 1 in  $y$  from  $G$  to  $G^1$  then the values become

$$cG = h \cdot x \left( \frac{y}{y-x} \right) - L \dots \dots \dots (4)$$

$$cG^1 = h \cdot x \left( \frac{y}{y+x} \right) - L \dots \dots \dots (5)$$

Of course if either of these formulae works out to a negative value it means that the length of diversion due to the limiting curves is greater than that due to the limiting grades and  $cG$  and  $cG^1$  can be neglected.

W. J. W.

## INFORMATION WANTED.

SIR,—Could you recommend me a good work on "Petroleum" and are any reports extant on the "Petroleum Finds" in Beluchistan?

Where and in what soil is it to be found?

DISTRICT ENGINEER, SIRMOR STATE.

NAHAN; November 25, 1888.

## THE C. E'S. OF THE P. W. D. AND THE U. C. S.

SIR,—It is supposed by many that we, as a body, comprising the Civil Engineers in the Public Works Department, have joined the Uncovenanted Service in their movement for Sterling Pensions. This erroneous idea may have arisen from the proceedings of certain members of our service in Simla and elsewhere. It is calculated to do serious injury to our prospects, and to delay our obtaining what we consider a reasonable condition of our service, namely, our pensions in pounds, as the only body of *Covenanted* servants of the Indian Government not paid in sterling.

It cannot be too soon known that we have not joined the Uncovenanted movement; a few weeks later will shew an irresistible majority in the Department, down, name by name (as soon as returns are collected), in favor of pressing our claim upon Government, entirely on its own merits, as concerning our own case.

X.

## PUNKAH PULLING MACHINES.

SIR,—The long looked-for invention of a contrivance, which should be the means of thoroughly dispensing with coolie labor in pulling our Punkahs, has at last shewn itself, in what may be relied upon, as being one of the most perfect machines of its kind ever brought before the notice of the public. The attempts that have been made ere this, to invent a machine of this class have been almost as numerous perhaps as those which preceded the adoption of the steam engine on our highways, instead of the old stage coach; and the obstacles to be met with were perhaps as many, the minds of men being as prejudiced as of old.

There is no doubt but that a "Punkah Machine" presents one of the most difficult questions to deal with, which has baffled some of the best mechanics; although at first thought it would appear as the easiest thing out. Men have spent their lifetime bent on solving this mysterious problem, some have given it up as a hopeless undertaking, a few fancied they were partially successful, but the points to be studied being found to be so harassing, that nothing but the most obstinate perseverance would help to conquer, have led them at the end to abandon the idea. A number have been successful in improving on those minor points, such as the "Punkah-wheel" and mode of suspending punkahs, &c. One individual of late, I notice, has come forward with what he claims to be a "Punkah Pulling Machine;" which no doubt it is as much as the ordinary punkah pulley that has to be under the control of a lazy coolie all the same: besides what the public want is not an ugly construction like the windlass of a ship, or a series of springs or weights hung about the walls to have their room appear like a clock-maker's shop. If the machine is to be anything at all, it must in the first place claim to do the work for which it is intended, and that without the slightest hitch; then again it should be as compact and as neat and attractive in appearance as possible, say something after the style of a sewing machine; and finally it should be effectually and economically worked, and be within the means of all. The gentleman that can now claim to be possessed of a machine of this kind, and which is the most finished little apparatus one would really wish to see, in fact a masterpiece of Engineering skill, is Mr. P. Venters of the Government Telegraph Workshops at Alipore. The machines can be seen at work at any time during the day; each of them pulls six punkahs. I send you a sketch of one as it stands; the size is about 12 inches square by 21 inches high; it is shewn covered in, in a mahogany case, and rests on and is fixed with a brass thumb screw to an ornamental bracket. Mr. Venters secured a patent, and for the past 10 years, he has been known to be perfecting his machine, and should be congratulated now on the success of his labors, and if any one is to receive the promised Government reward it will certainly be him. I will hail this invention as the greatest boon given to us next to our ice supply, both of which serve to make life bearable in India during the hot summer months.

I will now try and briefly describe what are the main points of interest that enter into the construction and working of this little apparatus. We all know something of pneumatic pressure, what a great agency it is, and can form an idea of the good results to be expected from its adoption, and to any one that has made it his life study, as in this case, he must ultimately create no little sensation, when he gives us in reality a test of its powers. This is what any one may avail himself the opportunity of witnessing and judging for himself if he can spare an hour to



drive back to the Government Workshops at Alipore. It will be understood as explained that compressed air is the agency employed, and I may assert that it is the only resource that can be utilized in a device of this description. The machine is so accurately adjusted that it will suit punkahs of any length of vibration, and can be converted in the space of a few minutes from the full length of stroke down to a few inches, so as to suit punkahs with short suspenders. The speed of the forward stroke or pull of the punkah is of an unlimited extent, dependent on the pressure applied; the return stroke is a free pendulum motion; the difference of the two speeds being attributable to the construction and position of the valves, combined by the manner in which the pressure is controlled. The valves are partly self-acting, being directed by the rod and springs. Another great advantage is the mode of connecting the ropes, and the attachments to, and arrangement of, the overhead pulleys; but above all, and the greatest achievement, is the simplicity of the whole construction, which is worthy of note, and any one looking at the machine can see this at a glance. I trust that the *Punkah Pulling Machine* will soon receive that recognition from Government, as it has already had from some of the best Professionals, which it truly deserves, and that its ingenious inventor will be amply rewarded for his labor, and that all may have the benefit of a reliable "Punkah Puller."

J. N. C.

[The above is from a reliable correspondent, and the sketch referred to bears out much of what is stated relative to the invention—Ed., I. E.]

## THE PRESENT STATE OF THE INDIAN P. W. D. AND ITS PAST HISTORY.

### VI.

SIR,—There remains one measure which is from the point of view of Government and of the more zealous of the officers alike absolutely necessary in the interests of economy.

It is the discharge of all incompetent, inefficient and useless men, a few of whom are to be found in every rank of the service. There is a small percentage, perhaps 10 per cent. of men whom no private employer would retain in his service for a day.

These men should be discharged on the pension they have earned by the amount of service they have put in, either paid as an annuity or the capital value in a lump sum together with one year's pay as gratuity. This may seem too liberal, but it must be remembered that it has always been understood that Government Service was permanent except for proved misconduct. The provisions of the Pay, Allowance, and Pension Codes, the Circulars of the Government and action of Government itself in reserving the right to dismiss for misconduct all point to this, and if men are compulsorily retired they must be adequately compensated. This is the only measure which will really involve expenditure, but few will be prepared to assert that the expenditure would be misplaced.

There are further certain internal reforms which are necessary to place the Department on a sound footing, which all depend on the fair carrying out of the principle of individual responsibility, but time does not admit of my following these out.

I will merely suggest that the supervision of the Examiner, who has no Engineering experience whatever, is a fiction. He can never tell whether the expenditure is necessary or is extravagant. He only knows if it is cast in the regular form or not. I could quote instances in which enormous aggregate rates have been paid without question, solely because the items were "in order." For large projects the Consulting Engineer to the Government of India must be the judge whether the proposed expenditure is reasonable or not, and a step in the right direction is seen in Colonel Gordon's proposed compendium. In detail the Superintending Engineer must be the final judge to the Executive Officers. Were it known that an officer's future career would be directly influenced by the quality and cost of his work, we should hear less of extravagant estimates and excesses over grants, and within the limits of the cash expenditure complete liberty might be allowed to Superintending Engineers, of allotment between different heads of the sums at their disposal. That some such scheme as I have drafted will be found necessary in the immediate future, there can be no doubt. What I have roughly outlined by no means provides for all the cases of injustice in the Department. It does not for instance touch the men who have suffered by supercession, depreciated furlough, pay and pension in the past. It does not compensate the unfortunate Cooper's Hill men in the blocked years who, though they entered the service after a more expensive education than the R. E's and under promises of equality average nearly 2 years less in each step of promotion. But we are convinced that some such reorganization would be hailed as a deliverance from present hopelessness and the apathy which inevitably springs from it.

Re-organization, whatever form it takes, will, I am convinced, only be brought about by steady pressure from within.

The case of the Civil Engineers is so peculiarly their own and depends so much on the intricate details I have set down that I fail to see how the general Unconvinced agitation can be expected to meet their case, even supposing it to be successful in its declared object, and that a Parliamentary enquiry is granted. In such a case the remedy is far distant while the need is urgent. It seems to me much more hopeful to take advantage of the known and expressed good-will of Government and the recent principles laid down by the Public Service Commission than to agitate with a heterogeneous body of very various deserts. I am sure that Government would gladly meet the just demands of the Civil Engineers of the Public Works Department. If I have seemed in the course of these letters to attack the Royal Engineer heads of that department, I have been misunderstood. The Royal Engineers have done great work for India. They are a select and picked body of gentlemen of high professional attainments and deservedly stand high in general esteem. In speaking of the selection of men of their own corps to fill all the prizes of the Department, I have been most careful not to attribute any intentional wrong doing to any officers of the corps of Royal Engineers. To deny that the officers of this corps who have so long ruled the Public Works Department have been most biassed in their action, and have in practice grievously failed to utilise to the advantage of the public service the power that has been confided to them, would be simply to fly in the face of well known and well proved facts. But I am perfectly willing to admit that this bias has been unconscious. If the Royal Engineer heads of the Public Works Department have obtained for the officers of their own corps numerous advantages, and have systematically exercised their power to the prejudice of men more than equally qualified, it is scarcely to be wondered at, and can be put down to a not unnatural and perhaps inevitable partiality of judgment. It is a well known axiom that the moral standard of men is lower in their public than in their private action, and it would be little short of superhuman, and is against all experience, to expect from Military Officers, united by a strong feeling of *esprit de corps*, by etiquette and tradition, by old companionship and associations, unbending impartiality and rectitude of judgment in matters where their own interests perpetually clash with those of men with whom they have nothing in common.

The offices of pleader and judge cannot be combined, and yet as the Civil Engineers are absolutely unrepresented with the Government of India, their case can only be heard through Royal Engineer heads of department who in the nature of things cannot feel how the shoe pinches.

The Public Works Minister has now a great opportunity of setting the department under his control on a sound basis. He will find much that I have said based on the minute of Sir Andrew Clarke, R.E., in 1877. He may earn the gratitude of men who now see nothing before them but a blighted career, poverty just short of destitution in old age, and who are at present moved by the bitterest feelings against Government which has, as they think, betrayed them, and are only restrained by their own feelings of pride and honour from dereliction of their duty. He may restore contentment and good heart to the Department and it should be remembered that contentment and efficiency go hand in hand.

VERITAS.

## THE CLAIMS OF C. E'S. IN THE P. W. D.

SIR,—A great deal has been written from time to time about the grievances of Engineers in the P. W. Department, but so diverse are opinions as to the nature of the grievances that even amongst men of the Department there is some doubt as to what are the main points on which we should agitate with a view to obtaining redress. The following are some of the demands I have heard raised by different individuals, and I have no doubt there are several more yet to be brought forward:—

- (i.) Sterling pensions or pensions at a fixed rate of exchange.
- (ii.) Equality of emoluments with R. E's.
- (iii.) Leave and Pension Rules to be the same for all European C. E's.

It may be stated generally that (i.) is sought for by the more senior members of the Department; (ii.) by Cooper's Hill men and (iii.) by Roorkee and other men whose names are not included in Schedule B of the Civil Leave Code. It is to be understood that these are the main points on which each class considers that redress should be given; thus, while the senior men do not object to "equality" they would not agree to its being brought forward if the pension question were adversely affected thereby. Cooper's Hill men desire the pension question to be mooted, but they hold that it would follow on the granting of "equality," and the remainder of the Department seek for equality with their Professional brethren. It would be difficult to reconcile so many different views and interests, but I will endeavour to point out what, in my opinion, is the wisest course for us to adopt, in order that we may attain at least some of our ends.

Firstly as regards Pensions.—I believe every member of the



Department will agree that pensions in sterling or at a fixed rate of exchange are a "*sine qua non*." Until this is granted, men will refrain from retiring, and promotion will be blocked. The question then is, what should be the scale of pensions? There seems to be a consensus of opinions that we are justified in asking for the same pensions as the Staff Corps and Indian Medical Service, and I have heard of no strong arguments brought against this proposal. The average pay and prospects of C. E.'s. have fallen so low that Government might well grant them retiring allowances on which they would be enabled to live at home, and until these are granted there will be just grounds for discontent. I am positive that nothing but united action and constant pressure exercised at home will secure us this object, and even then it is doubtful if we are strong enough to compel the India Office to take action. We have, however, a precedent on which we may find some hope. The concession of the 20-year Pension Rules was due to continuous pressure brought upon the Secretary of State, and if we renew that pressure and utilize all the influence we possess, or can obtain, we may yet succeed in obtaining sterling pensions on a reasonable scale.

*Secondly as regards Equality of Emoluments.*—In the Secretary of State's memoranda Despatch No. 18 P. W. dated 22nd March 1883, he desired "that in future the salaries of the R. E. officers admitted to the Department shall not be supplemented by Military pay proper, but shall only consist of the salary of the grade or office in which they may be serving." At the same time he desired that no grounds should be allowed to exist for the apprehensions expressed by C. E.'s. regarding selections for appointments "in the Secretariats or in the Department of Railway Control." The Government of India have found it possible to evade compliance with these orders, and although I would not press the question of Military pay, unless we could ensure our pay being raised to that of the R. E.'s, we have certainly grounds for complaint that in the matter of appointments the Secretary of State's wishes have been overlooked. So long as the advisers of Government are R. E. officers so long will the best appointments be reserved for that distinguished Corps, and the present tendency seems to be to place the whole State Railway Control in the hands of R. E.'s. There are therefore good grounds for raising this question, but I think it should not be put forward as our main grievance, but rather be made secondary to the vital question of pensions.

With respect to (iii.) the demands of Roorkee and other Engineers to be placed on the same footing as C. H. Engineers cannot logically be refused by the Department if equality is sought for. The difficulty seems to me this. The grounds on which we demand better leave and pension rules than the Uncovenanted Service are that we are a body of scientific professional men, trained at home at our own expense, while the Uncovenanted Service is recruited usually from a class of men who have not devoted time or money to training for a particular profession. Roorkee men are practically trained at the expense of the State, and though many of them have just grounds for asking to be enabled to retire to Europe, they are so mixed up with the body of the Uncovenanted Service that it is difficult to consider their claims separately from those of the European section of that service. I look forward to the day when all "non-domiciled" European Servants of Government will be granted sufficient pensions in sterling, but financial exigencies may defer that day to the dim distant future; meanwhile it behoves those who have been recognized by Government (by the grant of more favorable Pension Rules) as possessing superior claims to consideration to agitate for suitable pensions in sterling.

Having thus reviewed the principal demands of the Department, it only remains to add that there is, in my opinion, but one main question on which the Department is unanimous, and for which we should "go solid," to wit, sterling pensions. The first necessity in all agitations is to establish unanimity and then provide funds, and I am sure that when the Department realizes the importance of the movement now on foot every man will support it and abide by the decision of the majority.

PRO BONO PUBLICO.

### THE INDIAN BARRACK DEPARTMENT.

SIR,—In concluding my suggestions on the early amalgamation of the Military and Provincial Branches, I quite omitted to suggest the abolition of the present Barrack Department, not indeed so much on the score of its expensiveness, but on that of its utter uselessness. The most favorable report I ever saw of its work was that it relieved Executive Engineers from the trouble of the charge of Barrack furniture, and this is quite as much as can be said of it at the present day.

The Indian Barrack Department was founded and originated by the late Lord Strathairne, then Sir Hugh Rose, and Commander-in-Chief in India, as he intended, on the English model. That is, Barrack Masters were to be officers on half pay, on the then Invalid Establishment, men who were rendered (by wounds re-

ceived in action or sickness contracted on service) incapable of further active service, and Barrack Serjeants were to have been Non-Commissioned Officers who had served 21 years, or rendered incapable of further active service by wounds or sickness contracted on service, precisely as the Barrack Masters.

Instead of these humane and benevolent intentions being complied with, what is the state of the Barrack Department, and how has it been recruited ever since? By the admission of soldiers of a few years' service (generally private soldiers) who by sheer seniority in time become warrant officers and, as a matter of course, Barrack Masters. Thus a class of Warrant Officers has sprung up for whom the Warrant rank was never intended at all. Of course, there is no blame whatever attributable to the men themselves for this state of things; they have only availed themselves of the advantages held out to them by the system.

The remedy for this is abolition pure and simple; let the seniors have their pensions and all Serjeants of less than five years' service in the Department be returned to their Batteries and Corps. These might all be registered for the Commissariat Department and receive appointments therein as vacancies occur, or they might be attached as supernumeraries at once to the Commissariat and Transport Departments. All the remainder of the Barrack Serjeants to be pensioned as soon as they complete 21 years' actual service. No more Warrants to be conferred on Barrack Serjeants, but the present number of Warrants conferred on Barrack Serjeants to be given to the Serjeants on the P. W. D. list, and thus remove to some extent one of the hardships entailed by paucity of Warrants long endured by probably the hardest worked body of men in India, who have, from the nature of their arduous duties, to stand as best they can all vicissitudes of weather, from the snows of the *Kwaja Amran* to the heat of Mandalay and the malarious jungles of Burma.

To replace the present Barrack Department would be an easy task for Executive Engineers of Cantonments. The senior Warrant Officer of the P. W. D. in each Cantonment to be the Barrack Master of that Cantonment on his own departmental pay and allowances, assisted by junior Military Overseers of the P. W. D., who would thus acquire a knowledge of office work, a training which these men have no opportunity of acquiring at present. Indeed, all the senior Warrant Officers of the P. W. D. should be employed as Barrack Masters, the charge of small out-stations being held by the P. W. D. subordinate there stationed. These charges might be easily added to the departmental duties at present performed by the Warrant and N-C Officers of the P. W. D.

Thus thorough efficiency would be secured at no additional expense whatever to the State. This much needed reform should take effect from the 1st April next, simultaneous with the amalgamation of the Military and Provincial works.

E. R.

### "INFORMATION WANTED"—SUPPLIED.

SIR.—In reply to query No. 3 of your correspondent "M. S. E.," published in No. 21, INDIAN ENGINEERING, of the 24th ultimo, page 408, I beg to supply the extracts required.

E. B.

*Extracts from the Calcutta Gazette, Part I B., page 79 dated the 16th March 1887.*

#### LOCAL SELF-GOVERNMENT.

##### Part IX.

Qualifications of Candidates for employment as District Engineers, Overseers and Accountants.

1. Any person serving as a District Engineer under the Cess Act of 1880 at the time of the Local Self-Government Act coming into force, shall be deemed to be qualified for appointment as District Engineer of the same District.

2. A candidate for employment as District Engineer must be qualified in one of the manners following, i.e., he must:—

(a) Be at the time of seeking the employment or have previously been a member of the P. W. D. of the Government of Bengal, and hold a certificate from the Chief Engineer that his services have been such as to qualify him for employment as District Engineer, or

(b) Hold the degree of Bachelor of Engineering, or be a Licentiate of Engineering of the Calcutta University and have been employed on Engineering Works for not less than five years, exclusive of any time spent on apprenticeship, and hold satisfactory certificates of good conduct and efficiency during such employment, or

(c) Have practised the profession of a Civil Engineer in India for not less than five years, and hold a certificate from the Chief Engineer of the P. W. D., of the Government of Bengal, that his experience, professional attainments and knowledge of the native language are such as to qualify him for employment as a District Engineer.



## General Articles.

## KOJAK ROPE INCLINE.

Summit above M. S. L.	...	7,250 ft.
Length	...	1,500 "
Grade—Uniform the whole length		
= 35 feet per 100 or 1 in 2 $\frac{3}{4}$ .		
Gauge—5' 6".		
Maximum load—30 tons.		
Engine—250 H.-P.		
Rope steel wire—4 $\frac{1}{2}$ " circumference		
tested to 78 tons.		
Time of construction—Six months only.		

W. J. WEIGHTMAN,  
Executive Engineer.

N.B.—All machinery, appliances, &c., &c., made in  
N.-W. R. Loco. Shops at Lahore.

## BICYCLE RUNNING.

BY A. EWBANK.

## VIII.

OUR five equations are here for convenience reproduced.

$$\cos \omega = \cos \beta \cos \theta \quad (1)$$

$$\tan \sigma = \frac{\tan \beta}{\sin \theta} \quad (2)$$

$$\cos \lambda = \cos \beta \cos \theta - \sin \beta \sin \theta \sin \phi \quad (3)$$

$$\tan P U = \frac{\cos \phi}{\cos \theta \sin \phi + \sin \theta \cot \beta} \quad (4)$$

$$r \sin \lambda - c \sin \theta = c \sin \theta \{ \sin a + \phi - \sin a \} \quad (5)$$

We will now retain  $\beta$  and  $\beta^2$  and  $\phi$  and  $\phi^2$  and examine the form which the last equation gives for  $\phi$ . In retaining  $\phi^2$  we do not assume  $\frac{\phi}{\beta}$  a small quantity, although

we have reason to know that  $\frac{\phi}{\beta}$  is small when  $\beta$  is small.

$$\cos^2 \lambda = \cos^2 \beta \cos^2 \theta + \sin^2 \beta \sin^2 \theta \sin^2 \phi.$$

By (3)

$$= \cos^2 \beta \cos^2 \theta - \frac{1}{2} \sin 2 \beta \sin 2 \theta \sin \phi.$$

if we neglect smaller quantities than  $\beta^2$  or  $\phi^2$

$$= \cos^2 \theta \left( 1 - \frac{\beta^2}{2} \right) - \beta \phi \sin 2 \theta \text{ approximately.}$$

$$= \cos^2 \theta \left( 1 - \beta^2 \right) - \beta \phi \sin 2 \theta \text{ approximately.}$$

$$\therefore \sin^2 \lambda = \sin^2 \theta + \beta^2 \cos^2 \theta + \beta \phi \sin 2 \theta.$$

We are here retaining  $\beta \phi$  beside  $\beta^2$ , because we are only assuming that  $\phi$  is small, and not that it is small compared with  $\beta$ .

$$\sin \lambda = \sin \theta \left\{ 1 + \frac{\beta^2 \cos^2 \theta + \beta \phi \sin 2 \theta}{\sin^2 \theta} \right\}^{\frac{1}{2}}$$

$$= \sin \theta \left\{ 1 + \frac{\beta^2 \cos^2 \theta + \beta \phi \sin 2 \theta}{2 \sin^2 \theta} \right\} \text{ nearly.}$$

All our results are of course approximate.

$$\therefore \sin \lambda - \sin \theta = \frac{\beta^2 \cos^2 \theta + \beta \phi \sin 2 \theta}{2 \sin \theta}$$

Also as  $\phi$  is small

$$\sin a + \phi - \sin a = \sin a \cos \phi + \cos a \sin \phi - \sin a$$

$$= \sin a \left\{ 1 - \frac{\phi^2}{2} \right\} + \cos a \phi - \sin a$$

$$= \phi \cos a - \frac{\phi^2 \sin a}{2}$$

Therefore our equation (5) gives

$$\frac{\beta^2 \cos^2 \theta + \beta \phi \sin 2 \theta}{2 \sin \theta} = \frac{c \sin \theta}{r} \left\{ \phi \cos a - \frac{\phi^2 \sin a}{2} \right\} \quad (6)$$

This equation shows that  $\phi$  is comparable rather with

$\beta^2$  than with  $\beta$ . Therefore neglecting higher powers than  $\beta^2$ , we have

$$\frac{\beta^2 \cos^2 \theta}{2 \sin \theta} = \frac{c \sin \theta}{r} \phi \cos a$$

or

$$\phi = \beta^2 \cot^2 \theta \frac{r}{2 c \cos a}$$

The writer not having any bicycle by him, applied to the Manager of the Great Eastern Hotel who kindly sent him measurements of a bicycle. They were as follows: distance between centres 37 $\frac{1}{4}$  inches, diameters 54 and 18.

$$\text{These give } \sin a = \frac{27-9}{37\frac{1}{4}}$$

Thus  $a$  is a little less than  $30^\circ$ .

$$\text{Then } \frac{r}{2 c \cos a} = \frac{27}{75.5 \cos a} < \frac{27}{75.5 \cos 30^\circ}$$

$$\text{or } < \frac{108}{151 \sqrt{3}} \text{ or } < \frac{36 \sqrt{3}}{151} < .413.$$

Thus approximately  $\phi = \beta^2 \cot^2 \theta (.413)$  for that particular bicycle. Thus we exaggerate the value of  $\phi$  if we write

$$\phi = \frac{\beta^2}{2} \cot^2 \theta$$

for that bicycle when  $\beta$  is small.

If  $\theta = 90^\circ$   $\phi = 0$ , as should be the case, because then a  $\beta$ -rotation does not lower the front wheel. For values of  $\theta$  not less than  $60^\circ$ , we have  $\cot^2 \theta$  not greater than

$$\frac{1}{3}. \text{ Thus for such values of } \theta \text{ we may say } \phi < \frac{\beta^2}{6}, \text{ for}$$

the above given bicycle.

For a bicycle with its two wheels equal, our value of  $\phi$  will be different. We should then have  $a=0$  and  $c=2r$  approximately. Strictly  $c > 2r$ .

$$\text{Thus, } \frac{r}{2 c \cos a} < \frac{1}{4}$$

For this equal-wheel bicycle and values of  $\theta$  greater than  $60^\circ$  we have  $\phi < \frac{\beta^2}{12}$

Thus we may infer that for any bicycle we may put  $\phi$  as equal to or less than  $\frac{\beta^2}{6}$  when  $\theta < 60^\circ$

And as our results have all been approximate, and it is desirable to overstate the value of  $\phi$  rather than understate it, we will exaggerate the value of  $\phi$  and write

$$\phi = \frac{\beta^2}{4}$$

for values of  $\theta$  not less than  $60^\circ$ .

For values of  $\theta$  not less than  $45^\circ$  we have for the racing bicycle given above

$$\phi < \frac{\beta^2}{2}$$

and for the equal-wheel bicycle

$$\phi < \frac{\beta^2}{4}$$

We are therefore exaggerating the value of  $\phi$  when we write

$$\phi = \beta^2$$

for all values of  $\theta$  greater than  $45^\circ$  and for any ordinary bicycle. We may now consider what we shall get for the value of  $P U$  the final track deflection if we keep  $\beta$  and  $\beta^2$  and also  $\phi$  but neglect  $\phi^2$ .

We may write (4) as follows

$$\tan P U = \frac{\tan \beta \cos \phi}{\sin \theta + \tan \beta \cos \theta \sin \phi}$$

This reduces to

$$\tan P U = \frac{\tan \beta \cos \phi}{\sin \theta} = \tan \sigma \cos \phi$$

$$\text{Now } \cos \phi = 1 - \frac{\phi^2}{2} + \frac{\phi^4}{24} - \&c.$$

and as we only retain the first power of  $\phi$  we again have

$$\tan P U = \frac{\tan \beta}{\sin \theta}$$

even although we work up to and inclusive of  $\beta^2$ .



KOJAK ROPE INCLINE.



A. G. M.  
litho.











A B C is the curve a bicyclist describes who keeps his bicycle for a finite time at some constant angle  $\theta$ . On arriving at  $\beta$  the momentary track is a line H B K. If he can execute the small  $\beta$ -twist in a time extremely short the momentary track B K is changed to a momentary track B M. But as the bicycle front wheel is still on a slope—though the slope is somewhat changed—and for other reasons not here mentioned but to be given later—the new track will not be straight line B M, but some new curve B F G. The bicyclist must compare the angle F B C or M B K with the angle he gets, if he runs on a straight track for a second or two—his bicycle being upright—and then with equal suddenness gives the same  $\beta$ -twist. In the figure K B is a tangent to B C and M B is tangent to B F. The change of track must be studied *near* to B, because the subsequent movements are complicated by some dynamical reaction to be discussed later on. Our statement is that for a given small  $\beta$ -twist and an angle  $\theta$  of say  $60^\circ$  the angle K B M exceeds  $\beta$ .

We have now sufficiently considered the geometry of what we called the simplest solution. We have found that the secondary  $\phi$ -rotation does not sensibly disturb the new track due to the  $\beta$ -rotation. And the  $\phi$ -rotation we have found to be much smaller than the  $\beta$ -rotation when  $\beta$  itself is small. For example, let  $\beta = \frac{1}{20}$  which means an angle a little over  $3^\circ$ . Then we have found that for values of  $\theta$  over  $45^\circ$  we greatly exaggerate the value of  $\phi$  if we write  $\phi = \beta^2$ . Now  $\phi = \beta^2 = \frac{1}{400}$

This means an angle  $= \frac{360}{400} = 9'$ . And in these calculations we neglect such terms as  $\beta^3$  and  $\beta^4$ . Now  $\beta^3 = \frac{1}{8,000}$  and an angle  $\beta^3$  means  $\frac{9'}{20} = 27''$ . The neglect of such terms as  $\beta^3$  does not invalidate the general truth of our conclusions.

Thus we tell the bicyclist that his  $\beta$ -twist changed the track by the amount  $\frac{\beta}{\sin \theta}$ . Suppose  $\sin \theta = \frac{1}{2}$ . Then our estimate of the deflection is  $\frac{5\beta}{4}$ . This estimate is not

absolutely exact, but it remains true that the deflection is *decidedly* greater than  $\beta$ . It also remains true that the deflection increases (for a given value of the small twist  $\beta$ ) when  $\theta$  decreases. The *qualitative* assertions are all that we have made.

Now we may take up again the thread of our dynamical reflection. We have discovered that a small  $\beta$  requires in our simplest solution a  $\phi$  which is much smaller than  $\beta$ . The smallness of  $\phi$  is a recommendation to us that we should accept it. For a small movement needs only a small force.

If some other solution of the question how to keep the front wheel from working itself into the ground needed a large rotation of some mass, this would need a large force to command that rotation. A large movement needs a large force, because the large movement must be executed in the same time as the little movement  $\phi$  of our simplest solution. While the  $\beta$ -twist is sinking the wheel the restitution movement  $\phi$  must be undoing the sinking.

Such a movement as we have called a  $\phi$ -rotation is continually existing in the bicycle. Suppose the bicycle to be running at a high speed on a ground which is practically level or nearly level. Let the front wheel suddenly run into a deep basin-like depression in the ground. The whole mass (bicycle *plus* rider) has a linear or forward momentum which is nearly horizontal. In consequence of this the front wheel centre keeps for a moment its horizontal velocity. This wheel then for a moment leaves the ground. The upward ground pressure in the front wheel has thus disappeared. The hind wheel is on the ground and the weight of the whole mass acting through its C G begins to exert a leverage about the hind wheel centre. In consequence a  $\phi$ -rotation sets in. This rotation is in

the opposite direction to the  $\phi$  that we have been studying. We may therefore say that a negative  $\phi$  sets in.

If the front wheel suddenly runs on a little hill the front wheel plunges—so to say—and a positive  $\phi$ -rotation sets in. The actual amount of one of these restitution  $\phi$ -rotations depends partly on the depression or elevation of ground suddenly encountered by the front wheel. That is, if the level ground suddenly changes to an uphill road at a slope of  $20^\circ$  the effect in inducing a  $\phi$ -rotation is not the same as it would be if the slope was  $25^\circ$ . But  $\phi$  also depends on the speed of the bicycle. The greater the speed the greater must be  $\phi$ . This we may express by saying that bumping increases with speed. And  $\phi$  also depends on the slope  $\theta$  of the bicycle itself at the moment it finds the ground changing. A given  $\phi$  is not so effectual in lifting the front wheel when the whole bicycle is at a slope  $\theta$  as it would be with the bicycle upright. If we suspend a bicycle so that its plane is actually horizontal and then make it execute a  $\phi$ -rotation we shall not lift or depress the front wheel at all.

In introducing our "simplest" solution we said that any other solution geometrically suitable, *i.e.*, bringing the front wheel to a position just touching the ground could be derived from our solution by some or all of three additional movements. One was a rotation of the front wheel in its own plane. Call this movement P. Another was a rotation of the hind wheel in its own plane. Call this Q. The third was a movement of the whole bicycle as a rigid body. This movement will carry the bicycle horizontally. Its C G will then describe a line straight or curved. But this line will keep in one horizontal plane. This movement of the bicycle may be resolved into two movements. One will be a movement of pure translation. Call this R. The other will be a movement about a vertical axis for any other movement will lift a wheel from the ground. Call this vertical axis movement S.

Now the new additional frictions on the front wheel caused by the  $\beta$  twist act normal to the plane of the wheel. There can therefore be no P movement as due to these frictions. Similarly there can be no Q movement as due to these frictions. The R movement may itself be resolved into a movement in the old track and a movement lateral. The new or additional forces act normally to the track S that they cannot produce a new movement in the track. The vertical ground re-actions give no movement in the track.

Thus the only remaining movements dynamically possible are a lateral movement of translation and a rotating movement as a whole body about a vertical axis. A bicycle generally does not slip. If there is no slipping we may dismiss these last two movements.

We conclude therefore that under ordinary conditions a small  $\phi$  movement is dynamically as well as geometrically the solution of the question how to keep the front wheel from burying itself when its plane being at a slope  $\theta$ , a small  $\beta$  twist is executed.

#### ERRATA.

Page 392, for assumed angle  $\beta$ , read assumed angle  $\phi$   
 Page 393, left column for relation which connects  $\beta$  read relation which connects  $\phi$ .

Page 394, for  $c$  and  $\delta$  are constants read  $c$  and  $a$  are constants.

A REMARKABLE RAILWAY.—A remarkable strip of the new Rail way from Buenos Ayres to the Andes is probably the longest tangent in the world, extending 211 miles without a curve. It is further notable as having no bridge in the entire distance, and no cutting nor embankment exceeding about a yard in depth or height

SOLIDIFICATION OF PETROLEUM.—A most important discovery has recently been made, namely, the method of solidifying petroleum. The process is of the simplest; it is sufficient to add a small quantity of soap, and to heat the mixture which in cooling, gives a product sufficiently consistent to be cut into cube-like briquettes of compressed charcoal. This discovery allows of the use of petroleum as a combustible, which hitherto could only be done with difficulty, by reason of the difficulty of transport and of manipulation.



## RIVER CHANGES IN BENGAL.

BY J. D. BEGLAR, C.E.,

*Archæological Surveyor, and late Executive Engineer, of Ancient Monuments, Bengal.*

## II.

WE believe it needs no elaborate reasoning to preface the statement that the James and Mary Sands are caused by the mutual interaction of the currents of the Hooghly (the Bhagirathi) the Damuda and the Rupnarayan; it is we believe the accepted and the correct theory accounting for these dangerous sands.

The Rupnarayan, a stream rising in the high grounds about Raghunathpur in the Manbhum district, receives the drainage of but 5,000 square miles. Though of great breadth at and below Tamluk it is really, as is obvious from the restricted size of its basin, comparatively unimportant; we shall subsequently try to account for the great width at and below Tamluk. Here we wish to observe that the really small (as compared with the other two rivers) volume of silt or sand-laden water, which can possibly at any time flow through it, though not absolutely without some influence, is but a minor factor in laying the extensive and dangerous sandy deposits, just referred to.

The Damuda is a stream of a very different calibre, it drains a basin of nearly 12,000 square miles or nearly  $2\frac{1}{2}$  times the area drained by the Rupnarayan.

But this is not all, or nearly all, while the Rupnarayan drains barren and comparatively flat districts, the Damuda drains, the high forest covered table-land and hill slopes of Hazirabagh with its more than average rainfall. The Rupnarayan when it debouches from the Manbhum district on the plains of Midinapur and Bankura, is a stream but 100 yards wide with a dry season depth of about a foot; the Damuda when it leaves the same district is already a mile across, with a cold weather stream never less than waist deep.

Naturally, therefore, in considering the accumulated or mutual influences of the three rivers, Hooghly, Damuda and Rupnarayan, on the formation of the sands which have long been a danger to the ocean trade of Calcutta, the omission of the last-named influence from our calculations will least disturb the correctness of our conclusions. To avoid complication, we shall for the present suppose the omission made regarding the James and Mary Sands as practically due to the accumulated or mutual influences of the silt-laden Hooghly and the sand-laden Damuda in checking, diverting or otherwise moderating the individual currents that thus jointly, or severally, deposit their sands in the dangerous shoals.

That the tides must bring some, and by no means the least important contribution to increasing the volume of the deposit, would go without saying; but the action of the tides is not the subject of the present paper.

Admitting for the purposes of this paper that a certain, not inconsiderable portion of the sand deposits is due to the interaction of these two deposit-laden waters, it is of practical interest to ascertain whether some remedy, as regards this portion of the deposit, may not easily be found. Such a remedy, the least expensive and most advantageous, is prominently suggested by the antiquarian research relating to river changes given in the earlier part of this paper.

If we could divert the Damuda back to its primitive channel, obviously much of the deposit which it now contributes to the James and Mary will be made, and left behind opposite Balagarh or thereabouts; while the entire volume of its water, thus relieved of its undesirable burden, would be added to that of the similarly partially de-silted Hooghly. These combined waters, whose interaction above Hooghly Point now helps to form the James and Mary Sands, would then not only deposit the silt now laid there, but they would, over and above this negative advantage, be flowing unobstructed, and in larger volume; a *working power* to erode and remove the sands they have heretofore deposited.

That they would deposit a sort of "James and Mary" at or just below Balagarh is certain; but Balagarh is more than 60 miles from Calcutta, and the deposit would be of no consequence whatever to the ocean trade of Calcutta.

Vested interests, the demands of irrigation, sanitation and ordinary water-supply, in the districts through which the Damuda now flows, will practically prevent the diversion of the *whole stream* to the Burdwan-Balagarh primitive channel; nor would that be necessary; a regulated supply might be allowed to flow down the present bed, and a regulated supply also down the Salimabad-Noaserai Channel, while the bulk of the waters is left to find its way down the primitive bed, discharging near Balagarh.

The advantages of such a regulated arrangement would be the inevitable improvement of health from improved surface and subsoil drainage in the districts through which flow the primitive (proposed to be restored) and the Salimabad channels; both now holding stagnant and at best sluggish slime-laden waters which spread disease in place of health. As regards the lower course of the present Damuda, the destructive floods which annually devastate the districts, now on one-side and now on another, would cease, and with them the aim of the expensive Damuda embankments; which themselves removed, full facilities are afforded for surface and subsoil drainage, now rendered difficult or impossible by the embankments.

The advantages claimed are, therefore, numerous, and may be summarised as—

(1) The cessation of perennial additions to the James and Mary Sands.

(2) The gradual clearing away of the James and Mary by the increased volume of water thrown into the Hooghly *under conditions that preclude the possibility of this addition causing a deposit anywhere below* and for a long distance above Calcutta.

(3) The gradual deepening of the bed of the Hooghly at, and above Calcutta, in addition to the deepening below.

(4) The improved drainage and better sanitary conditions which districts above the primitive and along the secondary channel of the Damuda would enjoy.

(5) The freedom of the lower Damuda tracts from destructive annual inundations.

(6) The cessation of the heavy expenditure on the maintenance of embankments.

(7) The certain improvement in the drainage and sanitation of the lower Damuda tracts by the removal of the heavy embankments now arresting surface and subsoil drainage.

A few words are needed as regards the third in order of the advantages above summarised. It is well-known, and Sir W. Hunter's interesting paper has told us, that ocean-going ships such as used to be built in the eighteenth century, could and did find their way to the port of Satgaon; whereas now, ordinary river steamers find some difficulty in piloting their way between the shoals opposite Hooghly and Chinsurah, fully five miles below Satgaon! We shall, in a subsequent part of the paper, trace the closing of the Salimabad Channel of Rennell's "old" Damuda, back to certain permanent and great changes in the Ganges at Rajmahal, and to succeeding changes in the upper Bhagirathi, which took place *circa* the sixteenth century, but whose effects on the lower Bhagirathi, in the natural course of events, and in accordance with reasonable probabilities, would come to be felt, at and near Satgaon only much later.

Here we wish to point out that, so far as can now be inferred, the gradual silting up of Rennell's "old" Damuda on the one hand, and the gradual filling up of the Satgaon port and subsequent steady deterioration of the Hooghly as a navigable stream from Hooghly Point upwards on the other, appear to us in the relative positions of cause and effect. Our readers who have carefully considered the effects which the discharge of such a river as



the Damuda near Hooghly Point must inevitably have (by the formation of the James and Mary, and the retardation of the Hooghly current, on the bed of Hooghly at the junction), effects ever advancing higher up the river, will at this stage need but to be satisfied that the silting up of the Salimabad bed, in the inevitable gradual progress of the great change in the Ganges, can be reasonably assigned only to the period when Satgaon as a port *also* began to deteriorate, to realise, as fully as we do, the vast influence which this change effected. A change which ruined a capital at the source of the Bhagirathi, a port at its mouth; imposed on one great tract perennial malaria; and on another, no less great, inflicted the annual calamity of a destructive inundation.

That the Damuda may still be diverted back to its primitive bed, will be allowed, if it be remembered that the bed of that river must in the interval, between the first departure from the primitive channel, and now, have risen considerably, as the beds of all rivers flowing through low-lands subject to overflows always do; that the bed of the Hooghly must also from the same causes have risen may be admitted, but the bed of Damuda, which bears down in floods a larger volume of sediment of coarser grain, would rise more rapidly than of the fine silt-bearing Hooghly; consequently, there must be such differences between their respective levels now as were not when the departure took place: even if this probability of *additional facility* for retroversion to its primitive course be denied, the Damuda cannot, at least, have less available "fall" than it had then; therefore, *prima facie*, the retroversion of the river to its primitive bed is a subject which, considering the great advantages promised, must claim for itself a detailed and careful investigation. We do not say (indeed, no Engineer can in the absence of "levels" say with absolute confidence) that the project is certainly feasible: all we say is, that a practicable solution of immense value has, *prima facie*, been shewn as highly probable.

As regards cost, we shall content ourselves here with observing that the project would involve, not the cutting of a new bed, but the deepening of one already in existence; a deepening not by steam dredgers and such like uncertain or expensive processes, but by the manual labor that would bring food and work to the wretched people, who, as long as their homesteads and property lie at the mercy of the great river, will themselves so long remain the prey of poverty and starvation.

The cost of excavating the main proposed channel would, therefore, be under by a long figure, rather than over that of cutting a new bed; the same observation will apply to the deepening of the channel (for a very small width and, therefore, at a much smaller cost) of the Damuda which starts from Salimabad.

The great cost would it appears to us, be in a bund and regulating sluices across the Damuda near Burdwan; the distribution of the waters below Burdwan into the two channels, which bifurcate at Salimabad (one the present main channel, the other the "old" Damuda of Rennell) are works which would cost comparatively very much less. No regulating sluices would be needed across the primitive channel which it is now proposed to restore to its old function of main channel of the Damuda; it would probably cost less to widen it to the full capacity of carrying the entire floods of the Damuda, than to make it of insufficient width and then by expensive works to regulate the volume of water that shall enter it.

The very essence of the scheme, as it bears on the improvement of the Hooghly (an improvement not temporary and needing perpetual attention and cost; but automatic, permanent, perennial; needing no attention and working silently and surely though slowly) consists in allowing only the minimum of heavy sand-laden waters of the Damuda to flow down to its present junction with the Bhagirathi; all other considerations must be subservient; this object the greatest of all affecting to its very life the ocean trade of the capital of India.

We have now, we believe, shewn that the project, promising as it does, not alone the sure though slow removal of the dangerous James and Many Sand, but the improvement of the Hooghly river from Balagarh or its vicinity downwards, is not likely to demand an outlay which, the object being appreciated, could be called extravagant. Our readers must remember, that sums of money, reckoned by lakhs, have been, and are being used with admittedly incommensurate results, in the improvement of the Hooghly. In comparing this vast expenditure which must become permanently annual with the cost of our entire scheme, we have the well grounded assurance, that the latter will appear to be absolutely and astonishingly small.

It remains, if we have not written in vain, for public or private enterprise to cause such detailed levels and surveys to be taken and drawn, as could decide whether the scheme would be financially feasible (the lesser details can come afterwards); such surveys and levels would cost but little more than the salaries of the officers employed. We believe the present enforced inactivity of Government in the prosecution of public works will enable it, with but little special expenditure, to obtain the required information in sufficient detail.

## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

Burma, November 24, 1888.

Mr. P. B. Roberts, Executive Engineer, 2nd grade, on special duty at Shwebo, reported his return from privilege leave on the afternoon of the 6th October 1888.

Mr. E. M. Stevens, Overseer, 1st grade, Tharrawaddy Division, has passed the colloquial test in the Burmese language.

Lieutenant J. E. Capper, R.E., Assistant Engineer, 1st grade, reported his arrival at Mandalay on the forenoon of the 5th November 1888 and took up his duties as Personal Assistant to the Superintending Engineer, 3rd Circle, on that date.

Mr. R. D. Buck, Executive Engineer, 4th grade, temporary rank, was temporarily transferred from the Ruby Mines Division to the Shwebo Division, with effect from the 26th September last.

With reference to *Burma Gazette* Notifications, dated the 27th and 29th October 1888, respectively, Mr. H. F. White, M.I.C.E., Superintending Engineer, reported his return from privilege leave on the forenoon of the 23rd November 1888, and resumed charge of the duties of Superintending Engineer, 1st Circle, from the Chief Engineer, Public Works Department, Burma, on the same date.

Mr. C. F. McLeod, Assistant Engineer, 1st grade, Amherst Division, is granted three months' privilege leave, with effect from the afternoon of the 5th November 1888.

### Burma State Railway.

Mr. R. C. Beeston, Executive Engineer, 2nd grade, is posted to the charge of the 1st Division of the Mu Valley and Mogaung Railway Survey, with effect from the 20th November 1888.

Mr. F. R. Bagley, Executive Engineer, 2nd grade, sub. *pro tem.*, is posted to the charge of the 2nd Division, Mu Valley and Mogaung Railway Survey, with effect from the 20th November 1888.

Madras, November 27, 1888.

Colonel K. A. Jopp, R.E., Deputy Consulting Engineer for Railways, is appointed Under-Secretary to Government, Public Works Department, Railway Branch. This appointment will have effect from the date on which Colonel Jopp assumed charge of the Office of Deputy Consulting Engineer.

Punjab, November 29, 1888.

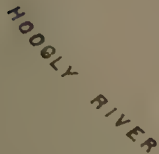
### Irrigation Branch.

With reference to Irrigation Branch Notification, dated 3rd November 1888, Mr. H. Garbett, Superintending Engineer, returned from 23 days' privilege leave on the afternoon of the 31st October 1888, and took over charge of the Derajat Circle from Mr. R. D. Bayley, Executive Engineer, on the afternoon of the 1st November 1888.

Mr. R. P. Russell, Assistant Engineer, 1st grade, Delhi Division, Western Jumna Canal, passed the Departmental Standard on the 5th November 1888.

Mr. W. J. Greer, Executive Engineer, 3rd grade, from the office of Superintending Engineer, Bari Doab Circle, to the 2nd Division, Bari Doab Canal, which he joined on the forenoon of the 25th October 1888, on return from the three months' privilege leave granted him in Punjab Government, Public Works Department, Irrigation Branch Memo, dated 27th November 1888.



OF *BENGAL*







N.-W. P. and Oudh, December 1, 1888.

*Irrigation Branch.*

With reference to Government of India, Public Works Department, Resolution, dated 22nd October 1888, appointing him as a Member of the Public Works Accounts Committee, Mr. R. A. Corder, Executive Engineer, 1st grade, was relieved of the charge of the Aligarh Division, Ganges Canal, on the forenoon of 1st November 1888.

*Buildings and Roads Branch.*

Babu Chundu Lal, Assistant Engineer, 3rd grade, is appointed to officiate as District Engineer of Hamirpur during the absence on privilege leave of Babu Aghar Lal Bose, Supervisor, 2nd grade.

With reference to paragraph 3 of the Resolution of the Government of India, Public Works Department, dated 22nd October 1888, His Honor the Lieutenant-Governor and Chief Commissioner is pleased to nominate Mr. J. Heinig, Executive Engineer, Meerut Division Provincial Works, to serve as a temporary Member of the Committee when it visits these Provinces to enquire into the system of Account work in the Offices of Executive Engineers of the Buildings and Roads and Irrigation Branches of the Public Works Department.

Mr. G. J. Joseph, Executive Engineer, 3rd grade, District Engineer, Meerut, will, in addition to his own duties, officiate as Divisional Engineer, Meerut, *vice* Mr. J. Heinig, during the period the latter officer may be engaged with the Committee.

Central Provinces, December 1, 1888.

With reference to Central Provinces, Public Works Department Notification, dated the 19th March 1888, Mr. J. B. Leventhorpe, Executive Engineer, on return from leave, reported his arrival in Bombay on the 19th November 1888, and is posted to the Eastern Division.

In continuation of Central Provinces, Public Works Department, Notification, dated the 23rd November 1888, Mr. J. B. Leventhorpe, Executive Engineer, reported himself at the Public Works Secretariat this day forenoon.

India, December 1, 1888.

Mr. H. P. Burt, Executive Engineer, 4th grade, sub. *pro tem.*, Assistant Secretary to the Government of India, Public Works Department, is transferred to the Oudh and Rohilkund Railway as Assistant Manager.

Mr. J. E. Dallas, Executive Engineer, 3rd grade, sub. *pro tem.*, State Railways, is appointed Assistant Secretary to the Government of India in the Public Works Department, with effect from the 17th November 1888.

The services of Mr. E. C. Elliot, Assistant Engineer, 1st grade, State Railways, are, on return from furlough, placed at the disposal of the Government of Madras for employment on Railways in that Presidency.

Mr. W. P. Richardson, Executive Engineer, 1st grade, North-Western Provinces and Oudh, is appointed to officiate as a Superintending Engineer during the absence, on privilege leave, of Lieutenant-Colonel G. T. Skipwith, R.E.

Bengal, December 5, 1888.

The Lieutenant-Governor is pleased to order that the Burdwan and Bhagulpore Public Works Divisions shall be amalgamated with effect from the 1st January 1889. The new Division will be called the Burdwan Division, and have its head-quarters at Hooghly.

Rai Khetter Nath Chatterjee, Bahadoor, Executive Engineer, is granted furlough for two years, with effect from the date on which he was relieved of the charge of the Burdwan Division.

Mr. Sorabjee Shavaksha, I.C.E., Assistant Engineer, 3rd grade, having passed the prescribed examination on the 6th November 1888, is promoted to the 2nd grade from that date.

The Lieutenant-Governor is pleased to make the following appointments with effect from the date on which Mr. T. H. Wickes returns from the North-Western Provinces and Oudh to Bengal:—

Mr. T. H. Wickes to be Superintending Engineer of the Western Circle.

Mr. H. Joll, Officiating Superintending Engineer, Western Circle, to officiate as Superintending Engineer of the Eastern Circle.

Mr. W. H. Nightingale, Officiating Superintending Engineer, Eastern Circle, to be Inspector of Local Works in the Bhagulpore Division.

Mr. W. H. King will continue to officiate as Inspector of Local Works in the Patna Division during the absence of Mr. Joll, on deputation, or until further orders.

*Irrigation.*

With reference to the notification of this Department, dated the 6th ultimo, Mr. A. S. Thomson, Executive Engineer, is posted to the Arrah Division of the Sone Circle. Mr. Thomson joined the Division on the afternoon of the 19th idem.

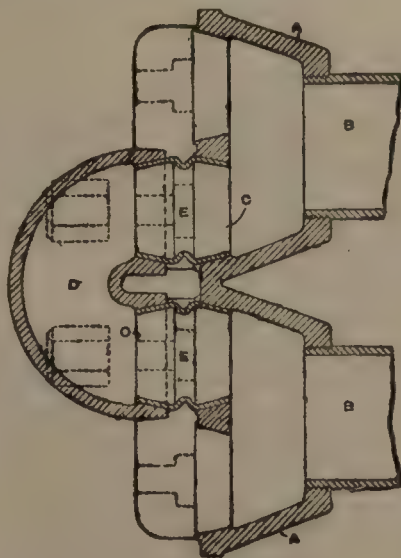
*Eastern Bengal State Railway System.*

Mr. A. Greenlees, Executive Engineer, is granted special leave for six months on urgent private affairs, with effect from 12th November 1888, or such subsequent date as he may be spared.

## Indian Engineering Patent Register.

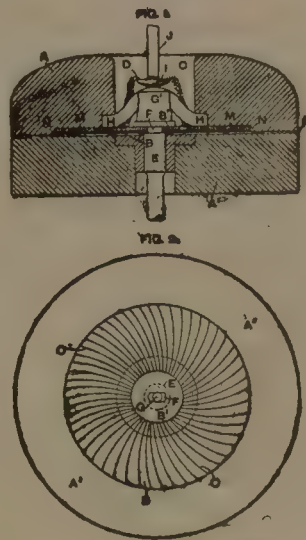
## RECENT BRITISH PATENTS.

STEAM BOILERS.—*C. S. Knap, London.*—This invention relates to the joints between the boiler shell and the tubes, and introduces an improvement into the method described in Patent No. 17023 of 1884, granted to the same patentee. The connecting piece consists essentially of a corrugated ferrule of a conical or cylindrical form, which will permit of a certain amount of play or change of shape of the tubes and their connections. The accompanying figure represents one of the



several formations of the ferrule here described. A are boiler tube boxes of a Roots boiler, and the ends of the water tubes B open into them. C are the joint connections with coned ends fitting and seating themselves in the seats in the boxes A and in the caps or bends D. These joints are provided with corrugations E, which allow a change of figure due to the expansion and contraction of the various parts and thus prevent any leakage. Two claims are made for these corrugated pieces, as described.—No. 11066. August 11th, 1887.

GRAIN GRINDING MILLS.—*F. J. Longton, Liverpool.*—In order to obtain middlings with the formation of as little finely ground flour as possible, the inventor hollows out the central portion of the surface of the upper millstone so that only the outside edges can perform the work. A method is also devised for preventing the accumulation of the grain in the central hollow portion. In the figures are represented a vertical section and plan of the apparatus. The central portion of the lower face of the runner A is cut away so as to form a recess an inch or two deep. A disc B of cast-iron is placed on the neck F of the driving spindle E, and it extends to within a short



distance of the periphery of the recess. Between the driving box G<sup>1</sup> and this disc is placed a leather washer B<sup>1</sup>. The grain falling on the disc B from the saucer I is propelled outwards by centrifugal force. In order to increase this force of propulsion a series of volute or radial grooves O are cast upon the upper surface of the plate. These ribs and grooves are unnecessary when middlings are being fed. The runner is driven by the arms H, and the grain is fed through the pipe J. Four claims are made for the use of the revolving disc for preventing the accumulation of grain round the centre and for the grooves in the disc.—No. 8827. March 12th, 1888.



## ADVERTISEMENTS.

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All Civil Engineers of the Department are informed, that, owing to the extended support accorded to the Civil Engineers' Association, the Committee feel it necessary to still further widen their sphere of influence, and to delegate some of their duties.

The current work has been entrusted to Local Sub-committees, who will correspond with the Central Committee.

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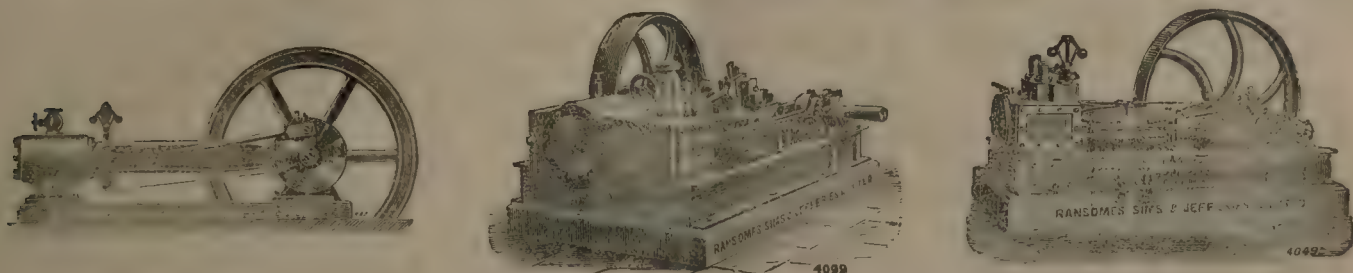
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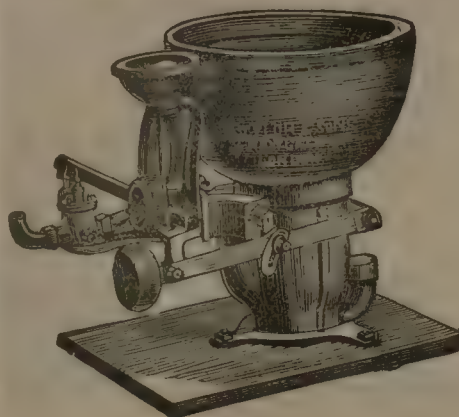
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Telegraphic Address—"SILVERGRAY," CALCUTTA.

## COMMERCIAL UNION ASSURANCE CO., LD.

Extracts from the Twenty-sixth Annual Report viz. for the year 1887.

### FIRE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£769,265 0 0
Interest ...	£ 19,612 0 0
Losses after deducting Re-insurances ...	£443,587 0 0

### LIFE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£125,559 0 0
Interest and Dividends ...	£ 45,649 0 0
Claims less Re-insurances, ...	£ 79,229 0 0

### MARINE DEPARTMENT.

Premiums after deducting	
Re-insurances ...	£175,118 0 0
Interest ...	£ 8,294 0 0
Losses after deducting Re-insurances ...	£138,365 0 0
Interest not belonging to above, but included in Profit and Loss ...	£ 18,545 0 0

The Life Fund was increased during the year by £65,648 and now amounts to £1,070,064.

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the uncalled Capital of £2,250,000.

The rates of Premium are moderate, but they are not unsafely low, and will be found to stand the test of time, thereby in conjunction with the ample Funds affording absolute security to the assured.

The Total Funds and property in hand on 31st December 1887 stood at £2,613,059.

(39)

C. H. OGBOURNE, Manager and Underwriter.

## PURE HYDRAULIC LIME.

FREE FROM ADULTERATION.

Numerous favourable certificates of the quality of our manufacture have been received, and the following are fair selections:—

J. H. APJOHN, Esq., Superintending Engineer, Kidderpore Dock Works, says:—

"Mr. McKennie's test for purity applied at Raneegunge shewed that it contained only 22 per cent. of insoluble matter, or only 1/3rd of the impurity allowed; there can be no question but that it is of very superior quality."

PAUL DEJOUX, Esq., Executive Engineer, Government Cement Experiment Division, reported:—

"It is the best Ghooting Lime imported into Calcutta."

JAMES KIMBER, Esq., M.I.O.E., Engineer to the Corporation of Calcutta, says:—

"It has been for long past and is now invariably used in all works, particularly drainage works. I have much pleasure in certifying to the excellent and reliable quality of the Lime."

O. A. MILLS, Esq., Executive Engineer, P. W. D., 2nd Calcutta Division, says:—

"The Ghooting Lime manufactured by Messrs. Burn & Co. is better than any that can be purchased in Calcutta. I have used it in the construction of many public buildings and have been thoroughly satisfied with it."

N.B.—Our Lime was used throughout all the River Works of the Calcutta Port Commissioners.

## BURN & CO.,

7, Hastings Street, or Raneegunge.

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## Notices.

The Office of Publication of *Indian Engineering* is at the "STAR PRESS," 19, Lall Bazar, Calcutta.

General correspondence, and all communications bearing upon literary matters, should, as heretofore, be addressed to PAT. DOYLE, C.E., Spence's Hotel, Calcutta.

It is particularly requested that all letters on business concerning subscriptions and advertisements be addressed to the "Managing Agents," MESSRS. BALMER, LAWRIE & Co., 103, Clive Street, Calcutta; and all remittances be made payable to them.

### Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	Rs. 18	Rs. 10-8	Rs. 6
Payable in advance.			

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### FOREIGN AGENTS FOR INDIAN ENGINEERING.

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### Scale of Charges for Advertisements.

One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
Rs. 50	Rs. 30	Rs. 18	Rs. 10	Rs. 6.

Double these rates for outside front.

An allowance is made for continuous insertions.

## NOTICE TO ADVERTISERS.

THE scope of this Journal makes it aspire to become the only thoroughly useful and trustworthy means of communication between the Profession and those who supply its wants. It should prove useful alike to users of machinery, engineering and building plant, or materials, and to the engineering trades generally, including manufacturers or importers in this country.

An object has therefore been to obtain for its columns special recognition as the best medium for ENGINEERING ADVERTISEMENTS in India. We use the word "India" advisedly since our circulation is not confined to any particular locality or province, but is pretty equally distributed all over the country.

It is hoped that the Profession will utilise the Journal more largely for making known its requirements, and the Editor's co-operation may always be relied on, should it be needed, for such purposes.

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# INDIAN ENGINEERING.

SATURDAY, DECEMBER 15, 1888.

## OURSELVES.

WE have been gratified by the receipt of several letters from all classes of our subscribers in reply to our inquiry relative to an enhanced rate of subscription, and the general opinion is in favor of the increase suggested. A Port Trust Engineer writes: "I for one quite agree with your proposal, and wish it every success." A well known Executive Engineer in Madras writes: "I am of opinion that the price of subscription might very well be raised." An Engineer on the South Mahratta Railway writes: "I cannot but pronounce that your valuable Journal is too cheaply spread." Many "don't mind increasing their subscription."

In our issue of 17th March last we mentioned that frequent suggestions had been made favoring an enhancement, and our hearty acknowledgments are due and are hereby tendered to our friends and supporters for the encouraging response now made, which we accept as an evidence of increased confidence on their part.

We have therefore resolved that from the 1st January next, the rate of subscription will be Rs. 18 per annum, including postage, with corresponding half-yearly and quarterly rates as notified elsewhere. These rates will not affect existing subscribers who have paid their subscriptions in advance, and will only come into operation for such at the period of renewal. All subscribers in arrear will be charged the new rate from the end of the year.

## THE EARLY HISTORY OF RAILROADS.

IN *Scribner's Magazine* for October there is a continuation of the interesting series of articles on Railway affairs in England and the United States to which we have frequently referred of late. *The railroad in its business relations* is the subject dealt with this time. At the outset the reader is reminded that the railroads of the world are worth now from twenty-five to thirty thousand million dollars, and that this sum represents probably one-quarter, if not one-third of the civilized world's invested capital. The capital employed in banking business is but a trifle beside this. The world's whole stock of money could purchase but a third of its Railways. It is well to be reminded now and again of these stupendous business facts, and they by no means measure the whole importance of 19th century applications of steam to locomotive purposes. Immensely increased opportunities for



business, and consequent increase of business, must be taken into the account, and such indirect developments in their full extent and entirety are incalculable.

As all our readers know, Railways started from very small beginnings. In the early part of this century, very few people foresaw that they would be able to compete with, much less to supersede the river-ways and canal-ways that were then the staple means of communication, and in the latter of which large sums of money had been invested, in England. They were started as tramways and were so called in honor of Benjamin Outram, who constructed, in the suburbs of London, a short line of railroad, worked by horses. Then came Stephenson, the steam locomotive, and an industrial revolution in its train.

When the year 1835 had been reached, there were, however, only 1,600 miles of Railway open, and in operation, throughout the world—more than half of that length in the United States. Ten years afterwards there were 10,000 miles, ten years after that again 41,000 miles, thirty years after that over 300,000. The progress made has been steady, uninterrupted, satisfactory—a truly wonderful development on the primitive idea in England, which regarded a railroad merely as an improved sort of turnpike road, on which the public might be allowed to run their own carriages, tolls being charged for the accommodation. An admirable example of John Bull's clinging love for precedent, and of how not to do it, involving danger of collision, as well as impracticability. Of course, it did not long endure. The owners of railroads soon found it advisable to provide rolling stock to run on them, and to retain in their own hands a monopoly of control over both. Moreover, there was doubling up, consolidation, of short connecting lines built for local traffic into main lines, journeying long distances. All which reforms tended to economy, as well as efficiency in working. The system of ownership and management in short, had to conform, to adapt itself, to the technical necessities of the business. To business minds in America the commonsense of the arrangement early commended itself. So did the importance of railroads as National lines of communication. But these were prejudices and vested interests to be contended with. We read in *Scribner* :—

"The idea was present in the minds of the projectors of the Baltimore and Ohio, of the Erie, and of the Boston and Albany. But it was not until 1850 that it became a controlling one; nor was it universally accepted even then. As late as 1858 we find that there was a violent popular agitation in the State of New York to prohibit the New York Central from carrying freight in competition with the Erie Canal. It was gravely urged that the railroad had no business to compete with the canal; that the latter had a natural right to the through traffic from the West, with which the railroads must not interfere. It is less than thirty years since a convention at Syracuse, representing no small part of the public sentiment of New York, formally recommended 'the passage of a law by the next Legislature which shall confine

the railroads of this State to the business for which they were originally created.'"

Seven years later, Vanderbilt, Fisk, Garrett—the American Railway Kings—were masters of the situation and fighting for absolute dominion like so many lions and unicorns fighting for the crown. The result of their rivalries and struggles was, we are told, "to place an enormous and almost irresponsible power in the hands of a few men. The directors of such a system stand between thousands of investors, tens of thousands of employes, and hundreds of thousands of shippers. They have the interests of all these parties in their hands for good or ill. If they are fit men for their places, they will work for the advantage of all. A man like Vanderbilt gave higher profits, larger employment, and lower rates as the result of his railroad work. But if the head of such a system is unfit for his trust intellectually or morally, the harm which he can do is almost boundless."

Congress was at last obliged to take the matter of Railway management up in earnest, and at last order was evolved out of chaos. Interstate Commerce Commissioners were appointed, and endued with authority, and consequently quite a spasm of virtue succeeded to virtually wholesale unconscientiousness. In the matter of strenuous virtue, it was even thought that some of the rival companies "stood up so straight as to lean over backwards." All's well that ends well however. But the writer in *Scribner* does not think the end has been reached; suggests that the "Interstate Commissioners" have laid down a few principles as to the cases when competition justifies through rates lower than those at intermediate points. But the application of these principles is as yet far from settled; and it is rendered doubly hard by the clause against pools, which does much to hamper the roads in any attempt to secure common action on the matter of through rates. Each ill-judged piece of State legislation, and each reckless attempt to attack railroad profits, increases the difficulty. There was a time when the powers of railroad managers were developed without corresponding responsibility. In many parts of the country they are now going to the other extreme—increasing the responsibility of railroad authorities toward shipper and employes, State law and national commission, and at the same time striving to restrict their powers to the utmost. Such a policy cannot be continued indefinitely without a disastrous effect upon railroad service, and, indirectly, upon the business of the country as a whole.

In this quotation sundry morals may be discovered worth the consideration of the Indian Government and the great guns who advise it as to the proper conduct of Railway affairs.

REWARDS FOR MERITORIOUS DISCOVERIES AND INVENTIONS.—The Committee on Science and the Arts of the Franklin Institute, of the State of Pennsylvania, desire it to be made known that the committee is empowered to award, or to recommend the award of, certain medals for meritorious discoveries and inventions which tend to the progress of the arts and manufactures.



## THE BOMBAY P. W. D.

THE chief defect of the new organization recently discussed by us for the Bombay P. W. Department is that by the abolition of the post of Chief Engineer and Secretary to Government, there is now no one really responsible for keeping down expenditure. A great spending department such as the "Public Works" should be under a single capable head, in order to secure undivided responsibility and unity of command. Now by the new scheme there are to be half-a-dozen or more heads, co-equal in rank. *First.*—There is the Secretary, a junior, who is responsible for the general administration. *Second.*—The four Chief or Superintending Engineers, whose powers extend only as far as their divisions; but who are in independent professional charge, and are not liable to be overruled by the Departmental Secretary. *Third.*—There is the Examiner of Accounts, who has been hitherto treated as the financial adviser of Government and supreme in matters of account.

We will suppose now, that under these numerous heads some scandal in the Department occurs, such as a waste of public money, on whom is the blame likely to be fixed? It is plainly impossible to divide the power without diminishing the responsibility.

Now, the duty of the former Chief Engineer was to exercise this general control, having special regard to economy. He was also intended to lessen friction, and to promote harmonious action in the different branches: to select the right men for particular posts; in a word, to administer the Department in the impartial manner, which only the most senior and capable officer can be relied upon to do.

With this post abolished, the Department will be in the same position as an army without a commander or a ship without a pilot. The four Chief or Superintending Engineers will be able to indulge their own whims and fancies in their separate divisions without fear of control, and the administration will be carried on by the Government advised by a Secretary who has never visited the works in progress. In our opinion if reform was requisite, it should have been in the direction of still further increasing the power and responsibility of the Chief Engineer. With this view all the work accounts should be submitted by Executive Engineers through the Superintending Engineers in order to make the latter acquainted with, and responsible for, financial irregularities.

This would reduce the work and the expense of the office of the Examiner, whose duties would be reduced to merely abstracting and collating the accounts. It is a mistake to treat this officer as a financial adviser of Government. His place is as a subordinate of the Chief Engineer, who alone should be consulted on matters connected with departmental expenditure. By concentration of power in one individual will be secured undivided responsibility, and this is essential to secure that interest in economy the want of which is now so apparent in the working of the Department.

## Notes and Comments.

MR. HORACE BELL.—We hear that Mr. Bell has reported unfavorably on the Great West of India Railway Proposals, and that the matter will now be dropped—till it is revived again. Mr. Bell has come to Calcutta—to find something to do!

AN ACKNOWLEDGMENT.—We have received from the Government of Bengal a copy of the Sixth Quarterly Inspection Report of the Dock Works at Kidderpore, which are being carried out by the Commissioners for Making Improvements in the Port of Calcutta, which we may notice later on.

BOMBAY UNIVERSITY.—The results of the recent Examinations in Engineering of the Bombay University are surprising when compared with either Madras or Bombay. No less than 53 candidates passed the first Examination by the old rules and 8 by the new rules, while of the 27 candidates for the L. C. E. Examination only four failed.

LONG RAILWAY BRIDGE SPAN.—The longest Railway bridge span in the United States is now the cantilever span in Poughkeepsie Bridge, 548 feet. This is said to be the widest *completed* Railway span in the world. The great Forth Bridge, now in process of construction, will have a span of upwards of 1,700 feet. The Rohri span of the Indus Bridge at Sukkur will be 820 feet.

SAUGOR ROADS AND THE MOUTH OF THE HOOGLY.—The depth of the Gasper Channel has increased by one foot, but the entrance into Saugor Roads is still very narrow, and a bar is likely to form unless the sands clear away. The pilots have asked that a light-ship may be stationed there all the year round. Commissioners for Making Improvements in the Port of Calcutta will be asked for a report on this point.

STRANGE IF TRUE.—One of our correspondents writes, "Burma is afflicted with a blind Executive Engineer, that is, that his vision has become so imperfect that he cannot read a letter and that a clerk has to direct him where he is to sign his name when documents are placed before him for that purpose. This officer's retention in office would appear a scandal to the P. W. D. as well as an infliction on his superior officer."

THE RUSSIAN RAILWAY TO VLADIVOSTOCK.—News reaches the Lahore paper to the effect that renewed energy is being shown in pushing forward the scheme of a Russian Railway to Vladivostock. General Annenkoff is busily engaged in promoting it. Whatever the political result of a Trans-Asiatic Railway from the Caspian to the Eastern Sea may be, there can be no doubt that it will have an immense effect in the development of Siberia.

MR. H. N. C. CLOETE.—It is said that Mr. H. N. C. Cloete, C.E., Executive Engineer, first grade in charge of the first Calcutta Division, Bengal Provincial Works, will take furlough to Europe at the commencement of the ensuing official year, but there is no truth in the rumour that on the expiration of his leave he may retire on pension. Mr. Cloete is only 40 years of age and a first grade Executive Engineer with a good future in the Department before him.



**AN INDIAN ENGINEER ON THE COLOMBO WATER-WORKS.**—Mr. Oldham's selection for the construction of the Trichnopoly Water-Works has encouraged him to venture on an expression of opinion relative to the Maligakanda tank failure. Mr. Oldham has tried to impress the Colombo public with the idea that the measures proposed to be adopted are not likely to obtain the desired result and offers suggestions as to what he thinks ought to be done.

**FLOOD DAMAGES IN LOWER BENGAL.**—The last issue of the *Calcutta Gazette* contains a "Resolution on the damage caused by floods in the Districts of Burdwan, Nuddea, Hooghly, Midnapore and 24-Pergunnahs, and on the Engineering questions involved; whether the construction of escapes for the relief of the flooded tracts is practicable, and whether the maintenance of the embankments is expedient." We hope to deal with the subject in an early issue.

**TIRHOOT STATE RAILWAY EXTENSION.**—The extension of the Tirhoot Railway from Baptahi to Pertabgunge, has just been passed for traffic by the Consulting Engineer, and will be opened in a few days; this brings the line to the bank of the Kori river, over the wide and shifting bed of which a temporary line will be opened for the present. It is proposed to remove the Traffic Superintendent's office from Somastipore, so as to concentrate it with the Manager's and Examiner's offices.

**BUDGET ESTIMATES OF THE BOMBAY MUNICIPALITY FOR 1889-90.**—The new loans required for 1889-90 are:—For Agripada District house sullage water connections, recently sanctioned by the Corporation, Rs. 2,48,000; Bouleshwur Market extension, Rs. 1,50,000; and proposed market at Foras Road and other works for 1889-90, Rs. 5,00,000; but it was resolved that, instead of the loan works for nine lakhs of rupees as proposed in the budget, the first two works for four lakhs only be sanctioned.

**THE MADRAS HARBOUR TRUST.**—Mr. R. W. Barlow, C.S., has requested the Government to relieve him of the Chairmanship of the Madras Harbour Trust, in consequence of a wide divergence of opinion as to the Chairman's administrative powers under the Act which has arisen between Captain Street, the Presidency Port Officer, and himself. We believe that it was a divergence of opinion such as this between Mr. Barlow and Mr. Thorowgood that led to the resignation of the latter. These incidents might well point a moral as well as adorn a tale.

**A NEW TORPEDO BOAT.**—Last week the *Leopard* a small torpedo boat, was launched from the Bombay Government Dockyard. She is of 90 tons, and is 95 feet in length, 17 feet 6 inches in breadth, and 8 feet 9 inches in depth, and has been built on White's "turn about" system under the supervision of Mr. G. F. Macklow, Head Constructor at the Dockyard. She will be fitted with ordinary compound engines of 350 horse-power and her speed will be 13 knots. The cost of the vessel will amount to about one lakh of rupees, and when she is completed at the end of next January, she is to be sent to Calcutta.

**ASSAM TO BURMA.**—The road from the Nichuguard to Kohima is precipitous in many places, and carts and elephants cannot pass along it, though horses can. But a good cart road is in course of construction for which one and half lakhs of rupees have been sanctioned. This cart road will pass through Kohima to Manipore and then probably to Burma. One lakh has been sanctioned for a

road from Kohima to Mhow, a station between Kohima and Manipore. A road and telegraph line now pass from Kohima to Sindwing in Burma, through Manipore. This is the direct and shortest way from Assam to Burma.

**CHENAB BRIDGE AT SHERE SHAH.**—Very satisfactory progress appears to have been made in the construction of the Railway Bridge over the Chenab River at Shere Shah, and which is one of the missing connecting links of the Sind-Sagar Frontier Railway. Should this progress continue, there is good reason to believe that the bridge in question will be open to traffic within a twelvemonth. The connecting link of the Chenab Bridge at Shere Shah is an important factor in the scheme for the defence of India; in connecting and completing the great lines of Railway communication, which are as admittedly necessary to the material prosperity of the country as to its defence.

**SOUTH INDIAN RAILWAY.**—Petty Contractors are wanted for the Villapuram Extension, for the supply of labor and building material, etc., etc. About 300 miles of new Railway construction has been started from Villapuram through Teriannamali, Vellore, Chittore to Terupatti and Dharmavaram. It is intended to carry out the work as far as possible on the Departmental or Petty Contract system, and the attention of Petty Contractors for labor and materials is invited to the undertaking. Subordinates such as Sub-Engineers, Masonry Inspectors, Surveyors, Supervisors, Overseers, and Maistries, well experienced in works of Railway construction, are also required.

**PROPOSED RAILWAY FROM CHITTAGONG TO DIBRUGARH.**—Mr. Bradlaugh asked the Under-Secretary of State for India whether the Government of India had before it a proposal for the construction of a Railway from Chittagong to Dibrugarh; whether one of the conditions of the proposal was the concession of land and of certain coal and petroleum rights; and whether he could state the full particulars of the proposal and by whom such proposal was made. Sir J. Gorst in reply stated that the Secretary of State has received two such proposals, which have been sent to the Government of India for consideration and report. Until a reply has been received it is undesirable that the particulars should be made public.

**THE TIRHOOT STATE RAILWAY.**—The *Indian Daily News* says that the particulars given of a recent fatal Railway accident at Motihari, on the Tirhoot State Railway, disclose a curious happy-go-lucky condition of things. Facts "show that care and efficiency are not very closely looked to on the Tirhoot State Railway" and our contemporary adds: "the occurrence and the history given of it has suggested, it may be hoped, to the superior authorities of the Tirhoot State Railway, the desirability of instituting a more efficient system of check, to ensure that the rest of the line is not worked after the thoroughly native, but extremely unsafe, fashion which is alleged to have been followed by the station staff at Motihari." Nevertheless, we have been assured that the line is now being worked on commercial principles!

**BENGAL COAL COMPANY.**—The report of the Directors for the half-year ended 31st October shows that the sales were 197,581 tons of coal against 212,673 tons for the preceding six months, making the sales for the twelve months 410,151 tons. The quantity of coal raised was 188,727 tons against 212,673 tons for the preceding half-year, making the total for the twelve



months 401,400 tons. The net profit for the half-year is Rs. 1,65,566, and adding the balance from the preceding half-year the amount available at credit of Profit and Loss is Rs. 3,57,243. The Directors have written off Rs. 30,000, which is the utmost limit allowed, to credit of Depreciation Fund, and they suggest that a dividend of 6 per cent. be paid for the half-year, which will absorb Rs. 1,44,000, leaving Rs. 1,83,243 to be carried forward.

**THE PROSPECT OF RAILWAY CONSTRUCTION IN ORISSA.**—Very hopeless, according to Sir Stuart Bayley, is the prospect of Railway construction in Orissa. Unless the Bengal-Nagpur Railway can be induced to run a branch from its main line to Cuttack and Puri, the Lieutenant-Governor thinks there is little likelihood of the wants of the people of Orissa being satisfied in this respect. The Government of India has for the time abandoned the direct initiation or guaranteeing of Railway undertakings, and its offer of liberal terms to any Company which will construct and work the Orissa line has so far failed to attract investors, while the resources at the disposal of the Local Government are quite inadequate for any such purpose as the construction of the much-needed line which is to give Orissa due facilities for communicating by land with other parts of India.

**WATER-SUPPLY OF MADURA.**—The following is the text of the resolution passed by the Municipal Council of Madura on Mr. O'Shaughnessy's report on the water-supply of the town:—"The Council feel convinced of the necessity for a complete system of water-supply to the Madura Town, and resolve to submit Mr. O'Shaughnessy's report to Government for consideration, with a request that they will make a selection of a suitable scheme having regard to the question as to how far the Periyar Project may be utilised in carrying the scheme out. The Council, however, regret the state of their finances will not admit of their undertaking such a large scheme without substantial aid from Government. They therefore beg that the Government will be pleased to sanction the grant of a moiety of the amount required for the scheme, and lend the other moiety at a low rate of interest."

**THE TRANS-CASPIAN RAILWAY.**—Accounts vary as to this great Russian Engineering triumph. The *Civil and Military Gazette* says, "Of course the Trans-Caspian Railway is not at present anything like our Indian lines, and some travellers describe it rather as a steam-tramway, or as resembling the class of line which our Engineers lay down to facilitate the serious construction of a Railway. The same holds good of the bridges. The Oxus Bridge, for instance, as we learn from private letters, gives constant trouble, and is always being broken when the river is in flood. During the floods of last August, fifty metres of the bridge had been washed away and passengers had to cross in boats. Nevertheless, a beginning has been made; and the Railway, such as it is, has already become an important political factor in Central Asia." Perhaps Colonel LeMesurrier could throw more light on the subject. We believe that he was favorably impressed with what he saw of the Russian line, and has expressed himself accordingly in his private report to Government.

**THE NEW DERA GHAZI KHAN PESHIN ROAD.**—This important line of Military communication is now, after three years of hard work, approaching completion, and was recently traversed by the Commander-in-Chief and

his party, who found that a first-class Military route has been constructed from the Valley of the Indus to the heart of the Afghan plateau. A bridge of boats now spans the Indus at Dera Ghazi Khan, and the station at Ghazi Ghat on the left bank has opened up Railway communication with the whole of India. The only obstacle to the complete development of the new line as a Military and trade route is the sandy plain, twelve to fifteen miles broad, lying below the mountain range. No heavy traffic along the road is practicable over this loose shifting sand, and no steps have yet been taken to metal this part of the road. Unless metalled, it will be practically useless for guns or cart traffic, and the value of the whole road will thereby be to some extent neutralized, as a chain is no stronger than its weakest link. Probably, however, the metalling of this section of the road will be soon taken in hand.

**RETIREMENTS IN THE P. W. D.**—Somebody makes a suggestion towards the removal of the present unprecedented block of promotion from which the officers of the P. W. D. are suffering. It is that "Government shall enforce their rule for the retirement of Chief Engineers after five years' service, and shall introduce another for the retirement of Superintending Engineers after, say, seven years' service as such. It is understood that Government intend to especially retire a number of officers next year, and a rule for retiring Executive Engineers at 50 years of age has lately been introduced. The hardship in retiring such men is far greater than would ensue to Chief and Superintending Engineers who draw much higher pay. Governors and Lieutenant-Governors give place to their successors after five years' tenure of office. Why should Chief and Superintending Engineers hold their places for ten and twenty years?" But there are *three classes* of both Chief and Superintending Engineers, which offer difficulties to giving effect to this suggestion not easily overcome. We may take this opportunity for making a correction. The "India" P. W. D. Notification, No. 293, quoted in our last was published in 1884, and not in 1888 as our printers would have it.

**KIDDERPORE DOCK WORKS.**—Good progress continues to be made in the Kidderpore Dock Works, and now, as nearly as possible, they are half finished. Three portions of the 60 feet lock have been built up to spring level, and the erection of the gates of the inner bar is about to be commenced. The quay walls of the Tidal Basin have been built for 72 per cent. of their whole length, and a beginning has been made at the 80 feet entrance and the double passage between the Tidal Basin and Dock No. 1. The foundations of the head of the Graving Dock are being got in under great difficulties, the soil being exceptionally bad, and it being necessary to timber for a depth of 45 feet in consequence of the closeness of the work to the Dock Works Railway and the Government Dockyard buildings. On Dock No. 1 78 per cent. of the quay walls have been built up to sub-way level, and the excavation of the Dock is in rapid progress. The Hydraulic Engine House is well advanced, but is now waiting for the handsome terra-cotta mouldings, cornices, &c., being made at Raniganj. The excavation of the Boat Canal connecting the Docks with Tolly's Nullah is nearly completed, and a beginning has been made on the lift lock and overbridges. Though half the work is done less than half the estimated cost has been expended.



## Current News.

THE lease of the Burma Ruby Mines to the Streeter Syndicate, will be for five years.

THE newly formed Bombay Art Society's first exhibiton of paintings, sculpture, and photographs is to be opened on the 4th of February.

MR. H. BLANFORD, Meteorological Reporter to the Government of India, at present on furlough, has sent in his papers to retire from the service.

SHOULD relief work become necessary in North Behar, it will probably take the form of an embankment for a Railway from Sitamarhi to Mozufferpore.

THE Government Telegraph Department, are we understand, making preparations to construct a line to Calcutta *via* Kendat, Tamoo, Manipur and Assam.

THE winter has set in with unwonted severity in Behar, and this, with other unfavorable circumstances, will affect seriously the prospects of the *rabi* crop.

THE permanant-way on the Oudh and Rohilkhund Railway between Benares and Mogul Serai is in a bad state, and the oscillation of the carriages somewhat serious.

MESSRS. SABAPATHY MOODELIAR & Co., of Bellary, are making superhuman efforts to start their Pondicherry Branch Spinning and Weaving Mills, on or about the 1st January next.

MR. GAMBLE, Conservator-General, Madras, has been paying the Dhoon a visit. The rumour is that when Mr. Fisher, Director of Forest Schools, goes home on leave, Mr. Gamble will officiate for him.

THE investigation into the fatality at Motihari, on the Tirhoot State Railway, has resulted in the arrest of the station-master, and the two pointsmen, for negligence. The trial will take place before the Magistrate of Motihari.

MAJOR J. B. KEITH, once Archæological Surveyor to Central India and the North-West Provinces, has conceived that the ancient monuments of India require conservation, and is preparing a general statement on the subject.

THE abolition of tolls for passengers, animals, vehicles, and goods travelling over the Howrah Bridge across the Hooghly at Calcutta, has at last been proclaimed by the Bengal Government. They will cease from the 1st of January next.

THE Municipal Commissioners of Bhagalpur have been authorised by the Government of India to raise in the open market a loan of Rs. 50,000, repayable in 37 half-yearly instalments, with interest at 6 per cent. per annum, in order to complete their water-supply scheme.

IN reply to an appeal from the Secretary of the Victoria Technical Institute at Bombay, the Standing Committee of the local Municipal Corporation have recommended an increase in the annual grant from Municipal funds for the institution from Rs. 5,000 to Rs. 10,000.

UNDER a recent decision of Government, Non-Commissioned Officers of Royal Engineers, who may be temporarily attached to convalescent depôts, in consequence of impaired health resulting from duty as submarine miners, will be allowed half their normal rates of Engineer pay while absent from duty.

THE new road from Gnatong to the Jalep Pass is finished, and is as good a track as one could wish for. From the Tukola to the Nimla, it is quite level, having been taken round the slopes of the hills, and it then descends with a gentle gradient to the mouth of the Jalep Pass; up the latter it has to go as of old, as best as it can.

## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*

### A QUERY.

SIR,—Will any of your numerous correspondents enlighten me which is the proper designation for open line inspectors—are they called P. W. Inspectors or Inspectors of Works, and are their offices called sub-divisional offices, when there are offices of Assistant and Resident Engineers as well? Further I shall be much obliged if you will kindly explain to me the distinction between the two—"P. W. Inspector" and "Inspector of Works."

DISTANT-SIGNAL.

### CONTINUOUS BRAKES.

SIR,—I beg to enclose you a cutting from *Iron*, of 26th October on the subject of continuous brakes. As the brake question is receiving so much attention in India, I think the information might be of interest to your readers, as shewing the opinion of Continental Engineers on the subject. The St. Gotthard Railway possesses the longest and steepest incline in Europe, and the Vacuum Automatic Brake was worked for a considerable time on this Railway, and proved that in its present form it was the most satisfactory brake for that line.

BRAKEMAN.

SUKKUR; December 1, 1888.

[The excerpt shews that "for the long steep gradients occurring on the St. Gotthard Railway the ordinary arrangement of the automatic Westinghouse brake was not considered perfectly satisfactory, as the pistons are not tight enough to allow a lengthened application of the brake without renewing the supply of air to the reservoirs from time to time, and it is somewhat difficult to regulate the action of the brake in this way, while besides, in case of its automatic application, the train has to be stopped while the blocks are released separately on each vehicle."—ED., *I. E.*]

### NORTH-WEST FRONTIER RAILWAY.

SIR,—Glancing at any map of the Punjab of to-day, one is fairly puzzled to make out the purpose, or purposes of the Sind-Sagar Railway. It is not a commercial line, it is not a political line, and it can surely have no pretensions whatever to be considered as a strategic line. If this was the object of the line, it is certainly the poorest attempt at strategy that has yet been attempted in India, or indeed for the matter of that, anywhere else; and as if the line itself were not a mistake sufficient, it is at the present moment being more than emphasized by the construction of a long and very costly Railway bridge over the Chenab at Shere Shah, some 5 miles below Mooltan.

A steam, or, for that matter, an ordinary ferry arrangement, would more than meet all the requirements of the scanty traffic on this paltry line, and Mr. Bell, Staff and Plant, transferred to, Kushalghur where the Indus is only 100 yards wide—*vide*, route No. 5 in Route Book of 1877. This would be only one span of 300 feet, as the banks are understood to be solid rock on one side at least if not on both. This would have been the most politic and sensible thing to have done in the first instance, leaving untouched the paltry Sind-Sagar line entirely. In addition to the bridge at Shere Shah, there is now the Kohat Bunnoo Railway under construction, and by the adoption of Kushalghur as the site for the connecting bridge, one large bridge (that at Shere Shah) might be saved entirely which, in these days of cheese-paring and Income-tax, is surely no trifling consideration.

E. B.

### "RAILWAY CROSSINGS."

SIR,—I should feel much obliged if any of your numerous readers would enlighten me as to the correct method of working out the lead of crossings. The old Platelayers' rule of twice the gauge into the denomination of a crossing is, I hear, now obsolete, and that a shorter lead is advocated, and should much like to know how the latter conclusion is arrived at.

Whilst writing of Crossings, an Engineer advocates a loose or slack gauge at the crossing, and the reason put forward is that when the gauge is tight the wheels of the vehicle have a greater tendency to ride on the nose, and that when slack, the wheels are prevented from riding the nose by the check rail.

Please let me know if this is correct. It is certainly contrary to the usual rule.

P. W. I.

November 28, 1888.

### FURLOUGH ALLOWANCES.

SIR,—*Apropos* of the official papers published in your issue of the 3rd November 1888 on page 356, I beg to relate my experiences for the benefit of my brother Civil Engineers.

After nearly ten years' service I was compelled to go home on leave, under medical certificate, having contracted malarious fever in working in the bed of a canal for over three months, from early dawn to late at night. The doctors ordered me home for one year, but this period proving insufficient, I got an extension of six months. My allowance for the first fifteen months of the medical leave was only £54 per quarter (that is, the equivalent of half my pay); but during the last three months of the eighteen I got quarter pay, that is, only £27 per quarter!

If a Civil Servant, or a Royal Engineer, or a Staff Corps Officer, or a Medical Officer goes on furlough, he gets a maximum of £250 a quarter and minimum of £125.



Please note that there was no minimum in my case. Moreover, as I was appointed by the Viceroy (that is, the representative of Her Most Gracious Majesty the Queen-Empress) of India, I am disqualified from counting for service for pension, any furlough or leave under medical certificate!

How just, how honorable, how generous are the Secretary of State and the Government of India! If India were governed by the much abused National Congress, or even the blood and iron Russians, the Indian Engineers could not be worse treated. Perhaps, Mr. Editor, you may be able to justify the illiberal and the ungenerous treatment meted out to the Indian Engineers by the Secretary of State and the Government of India.

#### INDIAN ENGINEER.

[We leave our rival, which is buoyed up by the sympathy of a Strachey, on the Council of the Secretary of State for India, where the Civil Engineers are unrepresented, "to justify the ungenerous and illiberal treatment meted out" to the large majority of the European Officers of the Public Works Department of India.—Ed., I. E.]

#### THE ARCHÆOLOGICAL DEPARTMENT.

SIR,—I see some correspondence in one of the Calcutta dailies in regard to the contemplated reduction of the P. W. D. Staff in Bengal.

Some time back I saw in one of your issues a scheme by which a certain number of the surplus officers of the P. W. D. could be usefully employed in the Archæological Department were that department reconstituted on the lines there indicated.

How is it that when one department is obviously suffering from want of trained Engineer officers, another department, which happens to possess a superabundance of them, contemplates, or is advised, to get rid of the surplus by retiring them on pension or bonus? If men must be retired on pension or bonus, would it not be in the end more economical to retire men who have no professional knowledge rather than those who have?

You have asserted, and it has not been contradicted, that none of the officers of the Archæological Department, except one, is, or has ever been, a Civil Engineer or an Architect; and yet, one of the principal duties, if not the one main duty, of these men is to prepare drawings of ancient buildings, to illustrate their architecture and elucidate their construction! It may be said that they have also to examine and report on the age of the buildings and on other points of purely antiquarian interest; admitting that this is so, as all or mostly all of these men when they joined the service must have been ignorant of Indian antiquities and have learned what they know (and it does not seem much judging from published results) since joining their appointments, is it not obvious that the surplus P. W. D. men who have to be retired on pension or bonus, would learn the antiquities at least as well, and probably much better than the untrained men who now fill up posts which only trained Architects or Engineers ought to fill? What are the men of the Archæological Department doing? Except some reports from the Madras section, not a single report or publication has been issued by the Department for the past three years; well would it have been for the Madras report not to have seen the light; your paper criticised it, but in terms not half severe enough. Your paper alluded to a Bengal report once, but no one seems to have seen it, at least it is not to be had anywhere, and is not published. Is this sort of thing to go on forever, while professional men who would probably turn out something tangible if they be in the Department are to be compulsorily retired? You profess to take up the cause of those unfairly treated, don't you think that you ought to put your suggestion of the employment of professional Engineers in the Archæological Department more persistently and prominently forward than you seem to have done?

#### COMMON SENSE.

[We may say that the "suggestion" made by us relative to the re-organization of the Archæological Department is now under the consideration of Government—the heart of the scheme being the employment of Professional Engineers instead of any one whom the Director chooses to employ.—Ed., I. E.]

#### DIRECTORY OF INDIAN RAILWAY OFFICIALS.

SIR,—Your rival extracts a list from the *Railway Engineer* and issues it as correct up to date. It is a case of the blind leading the blind. Glancing over the list with my imperfect knowledge of the wide field it covers, I observe:

1. Mr. Wynne is not put down as Agent of the B. N. Railway.
2. The B. and N.-W. Railway is repeated twice, and on the second occasion Mr. Rhind is given as the Loco. Superintendent.
3. Mr. Lightfoot is given as Auditor of the O. R. Railway (Guaranteed) Co. His name is also given again as Manager of the Sind Section, N.-W. Railway.

4. Colonel Wallace, R.E., Lahore, is given as Director of the Dhond-Munmad State Railway.

5. Mr. Carey is given as Resident Engineer of the Eastern Bengal, and Nalhati State, Railways.

6. The change of control in, or transfer of, the Nagpore-Chattisgarh State Railway, is not known to the Editor of your rival.

7. The death of Major Willans of Assam is also not known to him.

But why continue! Such is the knowledge and experience of one who undertakes to be the exponent of Professional opinion in India! *verbum sap.*

#### ANTI-IMPOSTOR.

#### THE P. W. D. OFFICES, LAHORE.

SIR,—The splendid design for the offices of the P. W. Secretariat, Madras, illustrated at page 312, No. 16, *INDIAN ENGINEERING*, forcibly reminds me of the old Military Barrack in which the Punjab P. W. Secretariat has been housed since the annexation of the Province in April 1849. True the old Barrack in question is not quite so ugly as the old Workshop at Madras was, nevertheless 'tis only an old Barrack at best; insufficiently lighted and ventilated, and but ill-adapted to the requirements of the present P. W. D. The total length of the Madras building illustrated appears to be 266 feet, and this is probably about the length of the old Barrack at Lahore. There would thus be little or no trouble in adapting the beautiful "façade" so well illustrated in *INDIAN ENGINEERING* to the present offices at Lahore, and this is the more urgent, because of the cramped space afforded in the present building.

True the principal façade would not be towards any of the important roads of the station, nevertheless a very suitable frontage might easily be obtained looking out on the Municipal Garden, and the ends of the building might be completed similar to the central portion of the façade, or by way of variety might be completed with Grecian porticos and pediments, and as the General Branch is at one end and the Irrigation Branch at the other, both would thus be suited alike.

I should also add that the miniature "kiosks" shewn on the elevation would be in perfect harmony with existing buildings in the immediate vicinity, as the Mayo School of Arts and Public Library. The whole of the proposed work should be executed in Tarakee Ashlar with rusticated quoins at the angles, all in Portland cement. The roof drainage pipes might, I think, be masked in pilasters discharging into a covered egg-shaped drain all round the building and sloping towards the roadside drain at the west end. The roof of the whole building should be raised and reconstructed on recognized principles instead of the present leaky mud roofing supported on trusses with struts and straining timbers—a most unsightly as well as unscientific construction. It can scarcely be expected that the present distinguished Chief Engineer of the Punjab, whose tenure of office will unfortunately expire in May next, will take up this matter; but had he the full time of five years' tenure before him, there can be no doubt that he would adopt and carry out the idea herein sketched with that earnest thoroughness which has been a distinguishing feature in his long service.

Even as it is, he can do a little towards the accomplishment of the work just now, as the Provincial Budget is just now being prepared, he enters an allotment, say, of Rs. 10,000 to Rs. 20,000 for the ensuing year, which might be utilized in stone of suitable dimensions, merely scabbled at the Tarakee quarry, being finally dressed at site, and by the time a sufficient quantity of stone has been collected, Mr. J. E. Hilton, Executive Engineer, Lahore Division, will probably have returned from furlough and ready to take up the work. Meantime, in addition, the permission of the talented Architect, who evolved beauty from worse than chaos at Madras, might, as a matter of courtesy, be solicited to adopt his magnificent design for Lahore.

To the next Chief Engineer of the Punjab then would fall the pleasing task of carrying out this splendid work, and an officer with a purely Architectural taste exactly suitable for this particular work is to be found fully matured in Colonel Beresford Lovett, C.S.I., R.E., who will undoubtedly be the next Provincial Chief Engineer, who has already displayed his taste in and for architecture in his design for the "Edwardes' Memorial Gate" at Peshawar and the "Principal Façade" of the Tilsal at Abbottabad, where he was serving as Executive Engineer, when the Kabul complications called him to the more congenial occupation of the "tented-field," than the comparative ease and comfort of that prettiest of stations in the Punjab, Abbottabad.

In conclusion, I would earnestly suggest that the present distinguished officer, who holds the reins till May next, will initiate the matter by entering the allotment suggested in next year's Provincial Budget, and thus indelibly inscribe his name on this "Temple of Fame" for the Punjab.

E. B.



## General Articles.

### UNIVERSITY SENATE HALL.

THE beautiful structure of which we give an illustration in this issue was erected from designs by Sir Gilbert Scott, R.A., F.S.A., F.R.I.B.A., the work commencing in March 1869 and being finished in December 1874. Towards the cost of erecting the Hall Sir Cowasjee Jehangeer, Kt., C.S.I., contributed Rs. 1,00,000, the actual cost being Rs. 3,79,389. The architecture is of an early French type of the thirteenth century. The Hall is 104 feet in length, by 44 feet in breadth, with a height of 63 feet to the apex of the groined ceiling, with a semi-circular apse of 38 feet diameter, separated from the Hall by an imposing arch. Round three sides of the Hall there is a gallery supported on ornamental iron brackets, and reached by stair-cases in octagonal towers at either side of the entrance porch. The facing is of Coorla hammer-dressed rubble in courses of 5 inches depth, pointed with Portland cement. The plinth is chisel-dressed Coorla, bases, capitals, cornices and all other dressings of Porebunder; shafts of blue basalt, except in the main entrance where they are marble.

The groining is turned in buff bricks with Porebunder stone ribs; the floors paved with Minton tiles and roofs of Taylor's patent tiles.

The interior of the building corresponds with the beauty of the exterior, and the brackets that support the gallery and railing are much admired.

In the Hall is a statue of Sir Cowasjee Jehangeer.

XENOPHON.

### RAILWAY WORK IN UPPER BURMA.

(Continued from page 415.)

#### II.

IN May 1887, when the earthwork of my original division, was nearly completed, an extension South, of 16 miles, was added to the Division, making 45 miles in all; this latter portion (with some high banks) was carried out during the rains, under greater difficulties even than the rest. Nine miles of jungle cutting had to be done; floods from hill streams often swamped the country, and it was difficult to move about, even on an elephant, while there was no shelter for the staff along the line. Labor, however, was plentiful, prompt cash payments had by this time quite gained us the confidence of the Burmese. The people here were poorer than those elsewhere, having but lately been allowed to return to their villages and cultivate again. In this district they had been all dacoits, and therefore under a ban for some time, no Burman being allowed to cultivate, or even live there; any met with could be shot. Thabyedaoung, the head quarters of the Sub-Division, is opposite a pass in the Shan Hills (the Nuttack Pass) through which, it was said, 30 lakhs of merchandise used to come in the old king's days yearly.

*Platelaying.*—The rails came up in August and were delivered about a mile north of my Division, where the line crossed the river Mitingnay, from flats direct from Rangoon. Over this river a timber bridge had been erected, and the rails were laid across and up to Mandalay shore. By this way we got engines and rolling stock on our Division. This bridge is worth describing: about 700 feet long, and 70 feet high from lowest bed to floor level, in spans of 35 feet, with double piers at every fourth bay where the cylinders (for the permanent bridge) were to be placed; for the piers 30 feet piles were first driven in, and the superstructure, erected on these. This work was completed by the late Mr. Dibblee in four months. The river had never less than 15 feet of water in it, and when freshes came down there was a rapid current. It proved most useful, as not only did it answer its main purpose well, which was for erecting the permanent girder bridge and putting down

the cylinders, but it allowed of all rolling stock for the Kyauksie Division being got over, and also gave us trolly communication with Mandalay, our only base of supplies. The permanent bridge, 4 spans of 150 feet with 2 land spans of 40, has since been completed and opened for traffic. We got our first engine over under rather trying circumstances: a heavy flood had heaped masses of debris against the timber bridge, which was swaying from the great pressure and the velocity of the current, our engine was on the other side, and it was of great importance that we should get it across. Just as the order was wired from Mandalay, "On no account pass engine over bridge," it was started off, and sent up a triumphant whistle in reply as it reached the other side; the line was very wavy over the bridge and it was risky work, but as it was possible (as it seemed at the time) that the bridge might go altogether it was necessary to get it across at all hazards. The rails were delivered at the base of a 20 foot bank during the rains, they had to be hauled up this and on the trucks. Plate-laying went on without ballast to the end of the Division, 45 miles, and was completed in March 1888. The bank was soft while the rains lasted, and work had to be stopped during heavy rain; at places the timber bridges were not completed, and the rails were taken on by trollies 2 to 5 miles from the head, bullocks were then used for pulling the trollies, and found more economical than men, a whole train starting off each night, for work next day, with a policeman on the top of each. Some platelayers were sent to me from Calcutta. These mostly turned out useless, and the bulk of the work was done by the Burmese. They turned out good workmen, the men loading the rails and women the sleepers, and most of this was done by contract at Rs. 450 per mile. After October, the rails for about 20 miles had to be brought by country boats from Mandalay down the Irrawady and up the Mitingnay river, as this last was too shallow for flats. This caused delay and trouble. Half a mile a day was done when everything went right. Police were not available to camp out with the platelaying gangs, and there were frequent stampedes when a village near was looted. Where diversions were put in, they were made as easy as practicable with curves of 1000 radius and gradients of 1 in 100. It is a very great mistake to make diversions difficult; slow running, and a few derailments will cost more by delaying work than the slight extra expense incurred in making these easy at first. As soon as the rains were over, we could run 15 miles an hour as we went on.

*Permanent Bridges.*—Early in December 1887, these were commenced. Rails being then laid for 20 miles, stone, lime and sand were railed to site, and the smaller ones soon finished. With the larger there was everywhere much delay in getting foundations in from want of plant, and bags filled with cement concrete for several feet deep were used in default of other means of putting in foundations, which were from 8 to 12 feet deep, canals, or perennial streams from the hills, keeping up water in all. Screw piles were available for some, but abutments had everywhere to be put in solid. Lime-stone was carted in to Kyauksie from quarries 5 miles off and there burnt for the whole Division in conical kilns with wood. The wood cost 15 Rs per 100 maunds; the lime-stone stacked cost Rs. 11 per 100 maunds, being a rich lime which would not set in damp or wet foundations without a certain admixture of soorkee. With one of sand and one of soorkee it made a most excellent mortar and would set well, with two of sand only in superstructure.

Rubble stone was quarried in the Kyauksie hill, and in another 5 miles north good quality fairly bedded crystalline sandstone. The soil nearly everywhere being impregnated with saltpetre, bricks were not reliable. Soorkee was brought from Mandalay in bags until a few bricks were burnt for this purpose, and it was no easy matter getting the Burmese to pound this. In one Sub-Division, after a whole day's talk, the head man who was burning bricks agreed to pound this at a certain rate, and the Engineer was considerably elated at having settled this



INDIAN ENGINEERING.



PHOTO-TYPE by James Akerman & Co. Queen Square London W.C.







himself with the man in pure Burmese, but that evening an Agent of the Bombay-Burmah trading Co. who could speak the language, found the contractor in much perplexity for he said the "Thakin" was not in joke. He spoke quite seriously, "but now I can manage two women for 8 annas, but I cannot do the same to four baskets filled with soorkee," the word pounding, in Burmese, being scarcely distinguished in sound from a word having one, with a different meaning, and perhaps oftener used in daily life by them. The matter was explained next morning and raised a hearty laugh among the workers, male and female.

Material was entirely railed to bridge sites, no other means of transport being possible, and the daily requirements of Sub-divisions, of stone, lime, sand and soorkee were not easy to meet, with carriage of permanent way going on at the same time. Two trains were devoted to this latter, and in February, as the lead grew longer, a third train had to be given for this, which altogether put back progress on the larger bridges during the most favourable time for working. The rate for labor only on masonry was at first Rs. 12 per 100 but this had to be raised to Rs. 16, the work done by imported labor; the Burmese tried it, but we could not afford the time to teach them. The total cost per 100 was estimated at Rs. 70, but it was done for about Rs. 50 I believe. Leaving before the books were made up for this work, I cannot be sure of the exact cost. By May the smaller bridges and culverts were finished in the first 30 miles and the larger bridges all in hand.

T. E. OWEN.

(To be continued.)

## BICYCLE RUNNING.

BY A. EWBANK.

### IX.

AN ordinary carriage has what are called springs. The geometrical action of a spring is as follows: Let A and B be two points of a body. Then if A and B are rigidly connected any movement taken up by A requires that a certain corresponding movement should immediately and entirely be taken up by B.

But if between A and B we insert a spring C the A-movement is initially absorbed by C and is then delivered more slowly and by instalments to B. While C does out the necessary movements to B, the A point possibly receives a fresh impulse which it passes into C.

In this way B is at any moment receiving partial effects of various distinct impulses. Thus B receives a resultant of various components and these components may be partly destroying each other. In fact, we may say that they must partly destroy each other. And we may add that they may entirely destroy each other. In other words, though A may continuously suffer impulses there may be moments when the resultant effect at B is *nil* or zero.

A bicycle has no formal spring, but each wheel is to a certain extent springy and so are the connections.

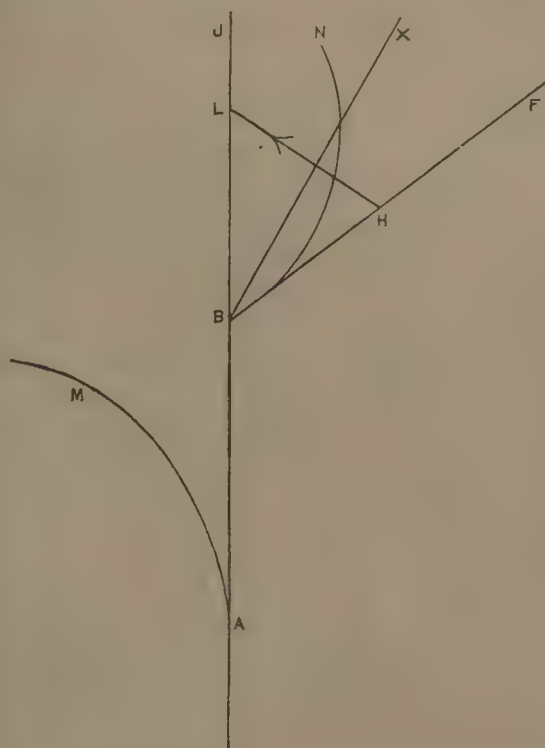
In this way a  $\phi$ -rotation indent instead of setting in immediately and fully to correspond to a  $\beta$ -twist of the handle, will be executed, so to say, by instalments. And while one instalment is being supplied to pay a back debt for one  $\beta$ , another instalment is supplied in part payment of a more recent  $\beta$ .

Again, let a bicycle suddenly run its front wheel into a depression. This requires a negative  $\phi$ . At that moment let the handle have a  $\beta$ -twist. This requires a positive  $\phi$ . The real  $\phi$ -rotation will be a difference of these and that difference may be zero. In such a case the ground just sinks away from the front wheel with such a rapidity that the  $\beta$ -twist does not cause the wheel to burrow into the ground. What is called the play of the machine is akin in its effects to a springy element.

Thus we see that our restitution  $\phi$  as needed by a twist  $\beta$  need not be delivered at once and that while it is being delivered in instalments other causes for  $\phi$  movements will intervene and will modify the action. Had our restitution  $\phi$ , as needed for the twist  $\beta$  not been small, it might only itself be slightly affected by those other  $\phi$  movements that result from slight elevations and depressions in the ground. But as we have proved that our  $\phi$  is itself small, we see that it may entirely be destroyed by that negative  $\phi$  which results from the front wheel running over a shallow hole.

And as the bicycle is continually on ordinary roads thus plunging down or diving—and plunging up or rearing—we may leave our restitution  $\phi$  as an undistinguishable element in the crowd of these little  $\phi$  movements.

Fig. 9.



We now pass on to another point in the dynamics of the bicycle. In fig. 9 A B J is the momentary track which we may suppose the bicycle to have just before a  $\beta$ -twist (clockwise) is given. The hind wheel, of which A is the lowest point, being on a slope  $\theta$  tends as an isolated wheel to run on a curve A M. The front wheel whose lowest point is B and whose plane is the new slope  $\lambda$  tends as an isolated wheel to run on a curve B N. The mass of the connections and the mass of the rider—or at all events a part of his mass—say the trunk of his body—tend to keep along the straight line A B J. But the front wheel runs off to the right hand in the momentary direction B F.

The consequence is that the front wheel is pulled laterally by the rest of the machine. The force acting thus on the front wheel is similar in direction to the line H L in the figure. This force tends to pull over the front wheel so as to lessen the angle which it makes with the horizon. We may say that such a force introduces an up-setting tendency. The actual effect on the front wheel depends partly on the mass that is pulling thus laterally. The effect increases if this mass increases. The effect depends partly on the mass of the front wheel. The effect decreases if this mass increases. The effect depends partly on the rotations of the front wheel and hind wheel. The rotation of the hind wheel increases the resistance which it offers to leaving the track A B or A M and following



the front wheel. For this following the front wheel requires the hind wheel to change the direction of its plane, and to this change the rotatory energy objects. Similarly the rotatory energy in the front wheel makes it resist, being pulled over so as to change its inclination  $\lambda$  into some less angle. This resistance is an added element to what its mere mass would give had it no rotation.

On the whole, we see that the front wheel must suffer to some extent, and thus that its attempt to run away (from the momentary track A B J) on what we may call the outside edge must result in its being partly pulled over. To this diminution in the angle  $\lambda$ —or what we might call an increase in the slope if we measured the slope from the vertical—we shall return in the sequel.

Meanwhile, we may notice that between the desire of the front wheel to take a track B F with a gradual bearing towards N and the desire of the hind wheel to keep the track A J with a gradual bearing towards M, and the desire of certain unrotating masses which are not small to keep the line A J without bearing to right or to left there must ensue a compromise, and the bicycle as a whole must choose some direction B X, which lies in the angle J B F.

And while the front wheel is being pulled into a less upright position the hind wheel is pulled so as to increase its uprightness, i.e., its approximation to uprightness, so there is a temporary disorganisation of the bicycle. A spectator watching it from a point in F B produced will see that its wheels have for a moment unequal slopes and different tracks. Some further compromise will be needed before the bicycle is again running in some undefined direction with its two wheels at one slope and on one track, or nearly so.

One great peculiarity of a bicycle consists in its having a rider. If it was wound up by clockwork like the little toy tricycles and set off at a slope to the horizon, its motions would be determinate and prophecyable. The human element introduces a variable quantity and the manner of its variation transcends the Differential Calculus.

A locomotive engine has also a rider who is generally called a driver. The rider of a bicycle is not generally called the driver. Thus a bicycle is compared rather with a horse than with a steam engine—and there is some reason for this preference. The driver of a locomotive after putting on steam may stroll about his little quarter deck and the locomotive takes no heed of his proceedings.

But on a bicycle the man does not stand but sit. And the bicycle is like an intelligent horse, it takes note of the slightest movement of its rider. Hence for any movement of the rider there comes in the question—was that movement judicious or otherwise? We left our bicycle a few paragraphs back in what we may call a bad way.

A ship in difficulties is sometimes said to be laboring, and we may describe our bicycle as being in a similar condition. One part of the bicycle is trying—so to say—to pull the other part over on its back.

The question now is whether the compromises of which we spoke are to be determined on purely mechanical principles, the rider being simply a heavy piece of clockwork that keeps the front wheel in rotation, or whether the human element is to appear in our equations and conduct them to new issues.

ERRATA.

(BICYCLE VIII.)

- Page 452 right column, for  $\theta < 60^\circ$  read  $\theta > 60^\circ$ .
- Page 453 left column, for final point read fixed point.
- Page 453 right column, for angle U V P read angle U C P.
- Page 454 left column, for pressure in front wheel read pressure on front wheel.

DAMUDAR BRIDGE, B.-N. R.

THIS Bridge is the largest undertaking on the Bengal Nagpur Railway. The site is a little below the confluence of the Burrakur river with the Damudar, with a waterway of nearly half a mile in width and a flood discharge of about 600,000 cubic feet per second. The Bridge, of which we give drawings, consists of 10 spans of 214 feet centres, with openings in the approaches at each end of 100 feet. The depth of the girder is 18 feet 3 inches. The greatest depth of foundation will not exceed 80 feet—the shore end piers resting on rock foundations and six intermediate ones on wells. The work is being pushed on rapidly—at a rate that bespeaks comparatively early completion.

THE PALACE AT UJAIN, CENTRAL INDIA.

SCINDIAH'S Estates in Malwa form a very considerable portion of his dominions, and in view of getting the youthful Maharaja to take greater interest in them Sir Lepel Griffin impressed on the Gwalior Council the desirability of providing a suitable residence for His Highness at Ujain, and employed Major Cole, R. E., formerly Curator of Ancient Monuments in India, to prepare the design. The site for the Palace is about two miles south of the Ujain railway station, on the elevated ground between the Sipra river and one of its tributaries, and the Palace and grounds, as designed by Major Cole, would occupy a space 2,320 feet square.

The plan consists of a central building 126 feet square, with a dome, connected by circular corridors with four corner buildings 80 feet square. The centre building, for the Maharaja himself, contains a Durbar Hall, dining room, library and sleeping apartments. Two of the corner buildings are for Maharanis and two others for offices and for Sirdars who may be in attendance.

The entire dome as well as the domes of the kiosques, are to be gilt, the buildings being faced with drab colored Nimach stone and red sandstone for mouldings, cornices, columns and ornamental parts.

The style is Hindu-Saracenic and the various details of the building are adapted from good specimens of Indian architecture.

AKRA BRICK EXPERIMENTS.

WITH AN INTRODUCTORY NOTE BY H. LEONARD, M.I.C.E.,  
Late Chief Engineer P. W. D., Bengal.

SUMMARY.  
First Series.

No.	Depth of Foundation below surface of the ground.	MAXIMUM SINKING WITH WEIGHT PER SQUARE FOOT OF			REMARKS.
		1 ton.	2 tons.	3 tons.	
		Sinking.			
		Inch.	Inch.	Inch.	
1	2 feet 6 inches ...	$\frac{1}{16}$	$2\frac{1}{8}$	$7\frac{7}{8}$	Including the weight of brickwork.
2	4 feet... ..	$\frac{3}{16}$	1	$3\frac{1}{16}$	
3	8 „ ... ..	$\frac{1}{16}$	$\frac{1}{16}$	$1\frac{1}{16}$	
4	11 „ ... ..	$1\frac{1}{16}$	$3\frac{1}{2}$	$7\frac{1}{2}$	Exclusive* of ditto.

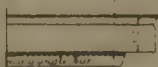
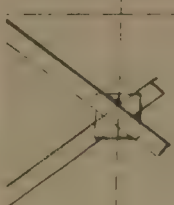




Roller joint

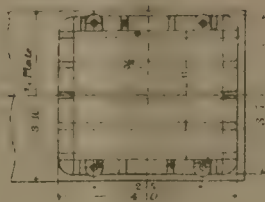
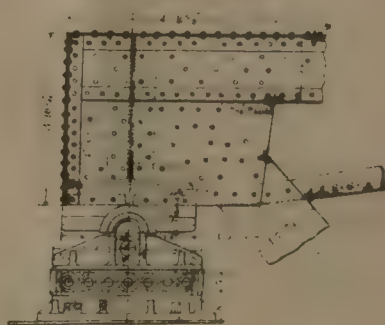
NOTE The position and axes of balls are the same as at expansion ends of girders.

VERSE SECTION



DETAIL AT EXPANSION END

SCALE 1 INCH = 4 FEET









**FIRST SERIES.** (Continued from page 433.)

Number of Experiments.	Depth below surface of ground.	Size of Pier constructed.	Total height of Pier.	Materials.	Total contents of Pier.	Weight of Pier at 100 lbs. p c. ft.	Superficial area of Pier.	Age of Pier.	Load, excluding weight of Pier.	Weight per sq. ft. including weight of Pier.	Result of Loading.		Remarks.
											Days.	Sinking.	
	Ft. In.	Ft. In.	Ft. In.		C. ft.	Tons. cwt. qr. lbs.	S. ft.		Tons. cwt. qr. lbs.	Tons. cwt. qr. lbs.			
6	4 0	2 9½	5 9	Bricks with mortar, two of soorkee to one of lime.	42·12	1 17 2 12	7·76	...	15 10 3 22	2 4 3 17·4	1st 2nd 3rd 4th	9 16 1½ 1½	No further sinking took place.
7	4 0	2 9½	5 9	Ditto ditto	42·12	1 17 2 12	7·76	...	23 5 0 24	3 4 3 5·2	1st end of 1st 3rd 5th	1½ 2½ 3 3½	On lowering screw jacks.
8	8 0	3 2½	10 6½	Ditto ditto	108·50	4 16 3 14	10·29	...	10 6 0 20	1 9 1 22·5	1st	3 10	No further sinking. The Executive Engineer states "heavy rain fell during part of the time of the last loading by which the ground was flooded and most probably water percolated to the foundation. This combined with very strong wind blowing from the south and east caused the unequal settlement of the block."
9	.....	3 2½	10 6½	Ditto ditto	108·50	4 16 3 14	10·29	...	20 13 0 3	2 9 2 5·9	1st 2nd 3rd 4th 5th 6th 7th	9 17 18 18 16 16 16	No sinking was observed from the 2nd to the 7th day.
10	.....	3 2½	10 6½	Ditto ditto	108·50	4 16 3 14	10·29	...	30 19 3 14	3 9 2 17·4	1st 1st 3rd 4th 5th 6th 7th 11th	1½ 1½ 1½ 1½ 1½ 1½ 1½	The result of this experiment tends to show that the bearing power of soil at 8 feet depth is no better for light weight than at 4 feet, but for heavy weight it seems to bear more.







## AMERICAN ENGINEERING NEWS.

(From our own Correspondent.)

MAJOR J. W. POWELL, the Director of the United States Geological Survey, proposes a great scheme for the irrigation of the arid lands of the West between the Rocky Mountains and the Missouri River. Several hundred thousand miles of territory are embraced in that region which are now totally unfit for cultivation. The plan involves the construction of great dams in the canons of the rivers of the region at points near the head waters, sufficiently strong to resist the flood waters of spring, behind which immense volumes of water could be impounded, and by means of canals distributed over the entire region as it would be needed. All that is required to render these vast tracts fruitful is the moisture now lacking, and the plan presents magnificent possibilities. Major Powell believes that by intelligent application of his plans not less than 150,000 square miles of desert land could be made productive, thus increasing by one-third the agricultural lands of this country, which is estimated to contain 300,000 square miles.

A bill is now before Congress appropriating \$250,000 for preliminary surveys looking to the reclamation of these lands. Many strong arguments have been made in favor of the immediate beginning of this great work, and the more the subject is studied the more important appear the direct results that may be expected even from the inception of the work. The minimum area of arid lands that may be reclaimed, if the construction of a system such as is proposed is found practicable, is 150,000 square miles, not one acre of which can ever be of any value unless supplied with water.

Professor George H. Cook, State Geologist of New Jersey and Vice-President of the Section of Geology of the American Association for the Advancement of Science read a very interesting paper before the Section at the recent meeting held in Cleveland, Ohio. His subject was *The Importance of Good Maps*. There is no man on this Continent who understands this subject better than Professor Cook. The recent series of maps issued under his direction as State Geologist of New Jersey are something marvellous, both in detail and beauty and excellence. Certainly, there is nothing like them issued either by the United States Government or any of the States. He says that the foundation of all geological work is a good reliable map of the country. "We are far behind the countries of Europe in respect to maps of the whole country; but it is believed that our later maps will not suffer in comparison with the best of those of foreign lands, and, from some experience in directing such surveys, I feel warranted in saying that no public expense incurred in carrying on scientific exploration meets with such hearty recognition and approval as that for making and publishing such information in regard to the topographic features of the country in which we reside or travel. To us, however, geography is of most interest, because the forms and features of the earth's surface furnish a guide to direct us in our geological studies, and a means of recording their results with accuracy and clearness."

Mr. Thomas C. Keefer, President of the American Society of Civil Engineers, in his annual address before that body at its Twentieth Annual Convention held in Milwaukee, Wis., chose for his subject *The Canadian Pacific Railway*.

He says that the Canadian Pacific is the work of Canada exclusively. The road was undertaken by Canada as a political and commercial one, to fulfill the compact with British Columbia, and unite together all the Provinces of the Confederacy, but chiefly in order to develop the vast estate purchased from the Hudson's Bay Company. It has been carried out by Canadians without any assistance from the Imperial Government, not even the endorsement of Canadian securities to obtain money at lowest rates, as was done in the case of the loans raised for the construction of the St. Lawrence Canal and for the Intercolonial Railway. Its importance to the Empire has, however, been recently acknowledged by the British Government, which unites with Canada in subsidizing a line of mail steamers between Vancouver and the British possessions at Hong-Kong.

The three natural features which governed the location of this road from ocean navigation at Montreal to the Rocky Mountains, on Canadian territory, were Lake Superior, Lake of the Woods and Lake Winnipeg. It goes north of the first two and south of the third. Going from the Ottawa Valley into that of Lake Huron, the line on to Lake Superior for

about one hundred miles traverses the watershed of Hudson's Bay near the height of land. In descending to Lake Superior long rock cuts are encountered, separated by shallow valleys, with marshy bottoms having little material for road-bed over them or near them, except solid rock, boulders and hard pan. Timber of the required dimensions being abundant, the grade was thrown up shortening the bottom line and reducing the depth of the rock cuts, and trestling was freely resorted to. Along the eastern shore of Lake Superior, high, rocky bluffs were encountered, and heavy rock cuts and tunnels were necessary. The rock excavation runs up to hundreds of thousand of yards on some miles. The cost of one mile was \$700,000.

The highest summit reached between Montreal and Lake Superior is 1,550 above tide, and the highest between Lake Superior and Red River is 1,560 feet above tide.

The maximum grade between Montreal and Lake Superior in either direction, is one per cent. and the minimum curvature 6 degrees. Between Lake Superior and the Rocky Mountains, the maximum grade going west is, with one exception, one per cent. Coming east, the maximum is 40 feet as far as Winnipeg on the Red River, thence to Lake Superior, 26 feet.

Mr. Keefer mentions an interesting example of rail creeping on one of the divisions where the road crosses a bog, or what the Indians call a "muskeg," causing it to yield 6 inches to every passing train. With a heavy consolidation engine, hauling 35 cars, this track crept 26 inches in the direction the train was moving.

He also says: that the rails creep for about three quarters of a mile east and about a half a mile west of a small bridge at the foot of a grade, in both directions. They creep in warm weather with every passing train, and will run 12 inches under an ordinary train. Track bolts break constantly. Cinder ballast keeps the track in line and surface fairly well, but does not prevent the rails from creeping. Lining and surfacing are therefore necessary at least once a week.

[This news letter and that following have been several weeks in type owing to the pressure on our space.—Ed., I. E.]

## NOTES FROM MADRAS.

(From a Correspondent.)

*The Madras P. W. Code.*—This plethoric volume has at last come under the notice of the local authorities. By a late G. O. the Examiner (Major C. H. P. Christie, R.E., who is also the Secretary of the Code Committee) was informed that no further modification of Code Rules would be considered until the Codification of the orders already issued had been completed, and the officers and subordinates had time to familiarise themselves with the numerous modifications already introduced.

A timely order indeed for officers and subordinates, as the standing orders to the Code were getting so numerous every day that it was simply impossible to digest them.

Why Madras alone should have a P. W. Code of its own is one of those questions that "no fellow understands."

*The Famine in Ganjam.*—The scarcity in Ganjam will have one good effect, and that is the re-opening of the Rushikulya Project Works, which the Government of India have authorised, and sanctioned a grant of Rs. 30,000 for the work. The work was stopped some months ago by the Government of India on the chronic plea of want of funds. The Chilka Lake Canal is another work that should be started, as it is eminently a relief work, and will be a remunerative one besides.

*The Periyar Project.*—Work on this Project is steadily progressing under the immediate superintendence of the energetic Superintending Engineer, Colonel J. Pennycuik, R. E. The machinery and plant are coming in and being sent up as rapidly as possible to the works. The want of roads to the site hampers this work a good deal. Extra establishment is being posted to the works, as they are sadly needed, especially in No. I. Division where fever has placed many of the establishment *hors de combat*.

*Late Changes in the P. W. D.*—The appointment of Mr. G. T. Walsh as acting Chief Engineer for Irrigation over the heads of Mr. J. W. Rundall and Colonel H. Vibart, R.E., has created quite a storm in the P. W. D. teapot. Mr. Rundall has left on six months' special leave, at the expiration of which he intends retiring from a Department that has proved so ungrateful. Colonel Vibart goes also on six months' special leave with a view, it is rumoured, of appeal-



ing to the Home Authorities against the injustice that has been shown him. Colonel Vibart has a good case, for if he was fit to hold the position of Superintending Engineer for a score of years, he was certainly fit for promotion to Chief Engineer. Unfortunately for Colonel Vibart he is not in favor with the powers that be, and as usual the weakest must go to the wall.

**New Postings.**—Colonel A. C. Smith, R.E., on return from furlough is posted to the charge of the IV. Circle, relieving Mr. Martin, Executive Engineer. Colonel D. McNeil Campbell, R.E., on return from furlough is posted to the charge of the VI. Circle, relieving Mr. Hughes, Executive Engineer. Mr. A. Malet, Executive Engineer, temporary, is appointed Assistant to the Chief Engineer for Irrigation and Under-Secretary to Government in the Irrigation Department, *vice* Mr. J. P. Davidson, Executive Engineer, going on furlough.

**The Cyclone.**—Madras was recently visited by a cyclone of great severity, causing much damage. The rain began on Monday night, the 29th ultimo, and fell incessantly during the two following days. Intimation was received by Captain Street, the Port Officer, by telegram from Calcutta on Tuesday, that a cyclone was approaching Madras from the Bay, and would probably strike to the north of Madras. The Port Officer at once warned the shipping to put to sea. The wind was blowing from the north-west, but the barometer was steady, and at 10 o'clock on Wednesday it stood at 29.80. It fell to 29.75 at 11 o'clock and stood at 29.55 at 3 o'clock. The wind increased in violence as the day wore on, and the storm was at its height between 8 and 9 o'clock when many of the roads were flooded, some over knee deep, although the bar (of the Cooum River) had been opened. Trees were uprooted in all directions, and the highways were blocked with fallen trees. The Victoria Hall suffered severely, the patent roofing tiles being blown off in considerable numbers. St. Andrew's Kirk has also suffered. The large metal ball (with the weather-cock attached) which had weathered the storms of the past seventy years—or nearly so—has been blown out of position, and now hangs threateningly down supported by the lightning conductor. If it had not been for this support, the ball, which is a heavy body, might have crashed through the dome of the Church, damaging it, gold stars and all. Telegraph communication was entirely suspended, as both the Government and the Railway telegraph posts were blown down. The water in the Cooum had partially subsided on Thursday, but owing to a large tank to the south-west of Madras having 'breached', the river overflowed on Friday and flooded the suburbs of Egmore and Poodoopet, causing much damage to the mud huts of the poorer classes who live here. The South Indian Railway's 6.30 P.M. train left as usual on Wednesday, but owing to the severity of the weather, there were very few passengers. All went well till Singaperumal Kovil Station was reached. Getting "line clear" here from Chingleput Station the train again proceeded. The train had hardly left the station when two large trees near the station were blown down, demolishing the telegraph wires and cutting off communication. The departing train had meanwhile with great difficulty—for the wind was blowing great guns—got to about half a mile of Chingleput Station and was skirting the lake which has about 12 feet of water in it, when the driver felt a shock and looking out found that the tender of his engine was derailed. He at once shut off steam and stopped his engine. Prying into the darkness with the help of his lantern, he found to his dismay that the whole train of 21 carriages had been blown over, and that the carriages were in an uncomfortable proximity to the water. This happened at half-past 9 o'clock, and as no immediate aid could be procured the passengers were at the mercy of the pitiless elements for several hours. The driver and guard eventually made their way to the Chingleput Station and procured assistance. When intimation of the accident reached Madras, a special was at once started with the *Loco* Superintendent, the Permanent Way Inspector and a gang of workmen. It is matter for congratulation that no lives were lost, the passengers escaping with a few bruises.

Of the vessels which left the port all returned in safety with the exception of the *SS. Bhundara*, which fared very badly. She had over 600 coolies on board, and was descried on the horizon on Thursday morning with signals of distress. The *Sirra* was sent to her aid and towed her in. Five of the coolies died from the injuries received, and 14 were brought ashore for surgical aid.

## Official Papers.

### PRECIS OF COLONEL TREVOR'S NOTE ON SECRETARY OF STATE'S DESPATCH.

1. SECRETARY OF STATE'S objects are—(a) Reduction of numerical strength to proportions sufficient for the work. (b) Re-adjustment of grades to increase promotion. (c) Improved terms of retirement, and (d) to fix the proportions of R. E's. and C. E's.

2. Omitting Military Works, Civil Branch is to be reduced from 888 to 761 officers. This reduction to be effected by gradually absorbing 66 men from Railways and by transferring the remainder (who are Military men) from other branches (not Railways) to Military Works. This proposal was on the assumption that Railways would in future be chiefly carried on by private enterprise, which does not now seem likely. On the other hand, Local Self-Governments will probably reduce the wants of Provincial branches. The future being so uncertain it is not considered wise to lay down any fixed scale. Successive Administrations have very different views regarding the scale on which Government should undertake Public Works, and unless the policy in this matter can be fixed (which seems quite impossible) a fixed scale cannot be laid down. There are at present 1,004 officers (including Military Works and 40 men lent on Local Works, &c.) To reduce these to 888 recruiting only the average required for this latter number would require over 30 years; if recruiting were quite stopped 10 years would be requisite. However the future permanent scale is not an urgent matter; recruiting can not be immediately stopped, as engagements have been entered into, and when it can be stopped the requirements may be different. But assuming that the department is to consist of 888 Engineers (660 C. E's. and 228 R. E's.) and that there are 128 R. E's. in Military Works, we shall require 30 to 31 recruits annually, of whom 4 would be R. E's., or including Military Works, 35 to 36 recruits annually, of whom 9 would be R. E's.

3. Re-adjusting grades to accelerate promotion.

The Department at present consists of 1,004 Engineers with monthly pay of Rs. 6,25,200. If officers all entered at 22 years and served until 55 years or death, the average lengths and ages would compare with actuals thus:—

	Typical.		Present.	
	Average age.	Average dept. service.	Average age.	Average dept. service.
Ch. Engrs., S. E's., & E. E's., I.	50	28	45-5	21-5
E. E., II.	44	22	40-3	15-5
E. E., III.	41	19	36-8	12-8
E. E., IV.	38	16	34-9	10-3
A. E., I.	33	11	31-8	7-9
A. E., II.	25	3	25-1	3-7
Total dept.	37-2	15-2	34	11-9

Thus present members of department are, on average, 3.2 years' younger and have 3.3 years less service than would have been the case if the department had grown up regularly. Thus the block in Assistant grades must be greatly aggravated if the present gradation is maintained and men only compulsorily retired at 55 years. The most junior Assistant would not in all probability be promoted to E. E., IV., until 1901. Secretary of State's proposal is to make E. E's. and A. E's. equal in number and the proportions in the E. E. grades to be 8, 9, 10, 12. This would at once promote 75 A. E., I., to E. E., IV., and 30 A. E., II., to A. E., I., but the congestion would merely be removed one grade higher. With this arrangement the average ages in the various grades in 1900 would be:—

Ch. E., S. E., and E. E. I.	Average age	51-8 years.
E. E., II.	47-2	"
E. E., III.	44-4	"
E. E., IV.	40-5	"
A. E., I.	33-4	"
A. E., II.	25-5	"

This is worse than at present or the future under the present arrangements (see table above).

In devising a new scheme for accelerating promotion it is necessary to determine (i) what the future rate of promotion is to be, and (ii) whether age or length of service shall be adopted for assimilating flow. The first depends on what Government is willing to pay. The more rapid the average promotion on a normal scale, the greater must be the promotion of numbers in the ascending scale of ranks, and the cost must increase in some direct ratio to the acceleration, *e.g.*, if the rate of promotion is fixed so that the average age of E. E., I., *et supra* should be 45.5 years as now, there would be 408 men of those ranks instead of 176, the present strength—*i.e.* all present E. E., I., and E. E., II., would be E. E., I., and drawing Rs. 52,800 per mensem more. If the remaining 600 men were divided into 5 groups of 120 men each, the time of service in each grade would be:—

A. E., II.	2 years.
A. E., I.	3 "
E. E., IV.	3 "
E. E., III.	4 "
E. E., II.	4 "

The additional cost in these lower grades would be Rs. 88,600 per mensem. The total cost of 808 Engineers of all ranks would cost almost exactly the same as present establishment of 1,004 men, *viz.*, Rs. 6,25,250 per mensem. The average pay of an officer of 33 years' service would thus be Rs. 777 against Rs. 629 on the present scale. This scale would immensely benefit juniors who would reach E. E., I., after 16 years, but it is no better than what present seniors have enjoyed owing to repeated augmentations of the department. The department no longer expanding stagnation in promotion results and discontent crops up. Any scheme tending to eradicate or reduce this



discontent is beneficial to the State as a preventive against inefficiency. It cannot be seen, however, that the department can be worked by 800 men, nor can men claim the abnormally high rate of promotion of the past. They are somewhat compensated by the better pensions now proposed. The conclusion is that 3 years in each of the Assistant grades and 5 years in each of the Executive grades is sufficiently rapid promotion. An officer serving through and retiring at 55 as E. E., I., would draw on average Rs. 703 or Rs. 74 better than now.

The numbers in each grade to ensure this would be :—

E. E., I.,	...	...	...	135
E. E., II.,	...	...	...	125
E. E., III.,	...	...	...	140
E. E., IV.,	...	...	...	155
A. E., I.,	...	...	...	160
A. E., II.,	...	...	...	100
				815
Ch. E. and S. E.	...	...	...	72
Total				887

But it would be better if numbers in each grade were equal.

However, the numerous small Provincial lists would vitiate the flow of promotion, some provinces having very rapid promotion, while stagnation would occur in others. The present system of gradation is also embarrassing in transferring men without infringing vested interests.

These difficulties would vanish if we had a system of incremental salaries dependent on length of approved service. There would be a clear field for transferring men, and mere seniority would be no claim for advancement to the higher posts. The idea is to divide the whole department into 4 classes. Officers to be appointed to 4th or lowest class on Rs. 350 if 22 years of age with increments of Rs. 20 per mensem annually until after 15 years' service Rs. 650 is reached. The utmost length of service in this 4th class to be 20 years when a man is compulsorily retired on Rs. 4,000 per annum. For exceptionally good service double increments might be given occasionally, or if unsatisfactory the increments might be suspended or even stopped; but these special increments are not to be more than to make the total salary greater than what would have resulted from increments averaging Rs. 25 *ab initio*.

Officers reported fit for promotion to the 3rd class would get it after serving on the maximum pay of 4th class for a year. The pay of 3rd class would commence at Rs. 680 with Rs. 30 annual increments, until 55 years is reached, or promotion to the 2nd class is attained. No special increments to be given in the 3rd class, as the reward for good service is promotion to 2nd class. Promotion to the 2nd class to be by pure selection from the whole body of the 3rd class who have 3 years' service in that class. Thus an officer would be eligible for promotion to S. E. after 16 years' service; a man shewing great capacity in 4th class and thus reaching the 3rd class in 13 years, might after 3 years in the 3rd class, if he maintained his reputation, be promoted to 2nd class. If failing to maintain his reputation for exceptional ability, but performing his duties satisfactorily, the maximum pay he would receive would be Rs. 1,250 during his last year of service.

No definite number would be fixed either in 3rd or 4th class; this would be left to the members qualified. Third class officers to hold the more important Executive charges, and the majority of the 4th class would be Assistants. It may be necessary to fix the numbers of the 1st and 2nd classes. In the two upper classes the incremental rule should apply. The pay of the 2nd class to commence at Rs. 1,100 with Rs. 50 annual increments. The maximum pay thus obtainable would be Rs. 1,950 (i.e., entering class after 16 years' service and retiring at 55 years.)

The pay of the 1st class to commence with Rs. 1,800 and annual increments of Rs. 100 up to Rs. 2,800. Selection for 1st class to be from 2nd class men of at least 6 years' standing in that class.

Other rules to be—(1) No officer whose salary in his class had in the usual course increased to more than the minimum of the class above should be eligible for promotion out of his class; and (2) the power of Local Governments to grant special increments in the 4th class should be limited to the amount of increments stopped or suspended; any excess requiring the sanction of the Government of India.

The first rule will prevent the higher classes being recruited by men past their prime, and the 2nd rule will preserve the general average of cost.

The foregoing is only for C. E's. The conditions of service of R. E's and C. E's are so dissimilar that with justice they cannot be placed on an identical footing.\* R. E's have Military aspirations and an increasing majority only serve the length of term of their foreign tour of service. It is of the greatest importance to Government both financially and on the grounds of superior efficiency to have a strong strain of the Military element in the department permeating all its ranks.† How is this result to be obtained without creating needless jealousies. Promotion among R. E's goes purely by seniority‡ and this should be maintained. Military Engineers should not be transmuted into C. E's to the detriment of *esprit de corps* and slackening of Military discipline. The present system makes it hard to find suitable posts for senior R. E's coming to India. It is therefore proposed to graduate the pay of R. E's in P. W. D. below the rank of S. E. according to regimental rank. In addition to net Military pay an officer to have Rs. 300 + Rs. 20 for every year of completed service from date of first commission. Thus a Lieutenant in 4th year of service would draw Rs. 70 + 300 + 3 × 20 = 430. Similarly a Captain would in 14th year of service draw Rs. 140 + 300 + 13 × 20 = Rs. 700. To put R. E's and C. E's on an equality for promotion to S. E. 21 years of completed service to be fixed as

a lowest limit of eligibility for an R. E. Thus ordinarily none ranking below a Major would be eligible. Similarly for Ch. Engineers 27 years' completed service would be necessary, corresponding generally to the rank of Lieutenant-Colonel. Increments of R. E's to be increased or suspended or stopped as for C. E's. The pay of R. E's in two highest classes to be as C. E's + net Military pay.

**Pensions.**—The State does not gain by early retirement of efficient officers. Under incremental scheme early retirements do not benefit the officers themselves. A pension as a provision for old age is necessary when rate of remuneration is insufficient for provision to be made from savings. The scale proposed by Secretary of State seems to meet all requirements except that the additions of Rs. 1,000 and Rs. 2,000 should not be restricted to S. E's and Ch. E's, many deserving men would be excluded from lack of opportunity. There may be a temptation to promote men to the higher posts only for their last 3 years of service so as to enable them to acquire the higher pensions. It is therefore recommended that after 28 and 31 years' service respectively the additions of Rs. 1,000 and Rs. 2,000 be given as well as to S. E's and Ch. E's.

Signed by COL. TREVOR'S INITIALS.

Addressed to MR. HOPE.

(To be continued.)

## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

Madras, December 4, 1888.

The following promotion is made :—

Mr. H. H. O'Connell from Assistant Engineer 1st grade, to Executive Engineer 4th grade, temporary rank, with effect from 24th November 1888.

The following postings are ordered :—

Major D. McNeil Campbell, R.E., Executive Engineer, 1st grade, to the charge of the VI. Circle. To join on return from furlough.

Lieutenant-Colonel A. C. Smith, R.E., Executive Engineer, 1st grade, to the charge of the IV. Circle.—To join on return from furlough.

Mr. C. Mildred, Assistant Engineer, 2nd grade, to the II. Circle for employment in the Kistna District under the orders of the Superintending Engineer.—

The following transfers are ordered :—

Mr. J. W. Martin, Superintending Engineer, 3rd class, temporary rank, from the charge of the IV. Circle to the charge of the Coimbatore Division.—To join on relief by Lieutenant-Colonel A. C. Smith, R.E.

Mr. W. Hughes, B.A., Executive Engineer, 1st grade, sub. *pro tem*, from the charge of the VI. Circle to the charge of the Madura Division.—To join at the public expense on relief by Major D. McNeil Campbell, R.E.

Mr. H. E. Clerk, Executive Engineer, 4th grade, temporary rank, from the charge of the Madura Division to the Tinnevely Division.—To join at the public expense on relief by Mr. Hughes.

Mr. A. S. Russell, Executive Engineer, 3rd grade, from the charge of the Tinnevely Division to the office of the Superintending Engineer, VI. Circle.—To join on relief by Mr. Clerk.

Punjab, December 6, 1888.

The services of Lieutenant-Colonel E. Harvey, R.E., Officiating Superintending Engineer, Punjab, are temporarily placed at the disposal of the Government of India in the Public Works Department for employment on special duty.

Mr. B. Parkes, Executive Engineer, is, on return from furlough, posted to the Kohat Division, which he joined on the afternoon of the 15th November 1888. He took over charge of that Division from Mr. Grant on the 19th idem.

#### Irrigation Branch.

Mr. F. C. Rose, Assistant Engineer, 2nd grade, attached to the 2nd Division, Bari Doab Canal, passed on the 5th November 1888 the Professional Examination as prescribed in Public Works Code.

Bombay, December 6, 1888.

The following is published for information :—

Furlough for one year on medical certificate, with the usual subsidiary leave, is granted to Mr. J. C. Lyle, Assistant Engineer 2nd grade, Bellary-Kistna State Railway, from such date as he may avail himself of it.

Central Provinces, December 8, 1888.

In continuation of Central Provinces Notification dated the 23rd November 1888, Rao Sahib T. N. Mukhopadhyaya, Assistant Engineer, surrendered, and Mr. J. B. Leventhorpe, Executive Engineer, assumed charge of the Eastern Division on the afternoon of the 29th November 1888.

N.-W. P. and Oudh, December 8, 1888.

#### Irrigation Branch.

With reference to Government of India, Public Works Department Notification dated 30th November 1888, appointing him to officiate as a Superintending Engineer during the absence on privilege leave of Lieutenant-Colonel G. T. Skipwith, R.E., Mr.

\* Why not when for their whole lives they do the same duties?

† Why?

‡ Then why not among C. E's?



W. P. Richardson, Executive Engineer, 1st grade, assumed and made over charge of the 1st Circle, Irrigation Works, on the forenoon of the 30th October and 20th November 1888 respectively.

#### Buildings and Roads Branch

With reference to Government of India, Public Works Department Notification No. 165, dated the 25th May 1888, Colonel J. P. Steel, R.E., took over charge of the Office of Chief Engineer, Buildings and Roads and Railway Branches, and Joint-Secretary to this Government in the Public Works Department, from Mr. T. H. Wickes on the afternoon of the 5th December 1888.

#### India, December 8, 1888.

Mr. R. Ring, Executive Engineer, 1st grade, Burma, is, on return from furlough, promoted to Superintending Engineer, 3rd class, temporary rank.

Mr. H. J. Richard, Superintending Engineer, 3rd class, temporary rank, will in consequence revert to his substantive rank of Executive Engineer, 1st grade, from the date on which he is relieved by Mr. Ring.

Mr. B. Rees, Sub-Engineer, 1st grade, State Railways, is granted the Honorary rank of Assistant Engineer.

Lieutenant Herman Bonham-Carter, R.E., is appointed to the Department as an Assistant Engineer, 2nd grade, and posted to State Railways. His services are placed at the disposal of the Director-General of Railways.

Mr. W. C. Rennie, Executive Engineer, 1st grade, State Railways, is granted special leave for one year, eight months and twenty-three days, under the terms of Public Works Department letter dated 3rd October 1887, with effect from the 17th July 1888.

The services of Mr. G. T. St. A. Nixon, Executive Engineer, 4th grade, temporary rank, State Railways, Burma, are placed at the disposal of the Government of Bengal, Railway Branch.

Captain W. H. White, R.E., Executive Engineer, 2nd grade, State Railways, has been granted furlough for 12 months, with effect from the 1st December 1888, by Her Majesty's Secretary of State for India.

#### North-Western Railways.

Mr. C. H. C. Bickerton, Executive Engineer, 3rd grade, sub. *pro tem.*, attached to the North-Western Railway, is granted one year and ten months' furlough to Europe, on medical certificate, with effect from the 1st December 1888, or such subsequent date as he may avail himself of it.

#### Bengal, December 12, 1888.

Rai Haran Chunder Banerjee Sahib, Executive Engineer, is transferred from the office of the Superintending Engineer, Western Circle, to the Burdwan Division, with effect from the afternoon of the 24th of November 1888.

Rai Radhica Prosad Mookerjee Bahadur, Executive Engineer, 4th grade, and District Engineer of the 24-Pergunnahs, is granted privilege leave for two months, with effect from the date on which he may avail himself of the leave.

With reference to Government of India, Public Works Department Notification of the 7th December 1888, Mr. G. T. St. A. Nixon, Executive Engineer, 4th grade, temporary rank, is posted to the Tirhoot State Railway.

With reference to the Notification of the Government of India, Public Works Department, dated the 12th October last, Mr. Bernard Heaton, Assistant Engineer from the Royal Indian Engineering College, is posted to the Chota Nagpore Division.

Mr. W. H. Rushton is appointed to officiate as Executive Engineer of the Darjeeling Division, during the absence, on deputation, of Mr. J. C. White, or until further orders.

#### Irrigation.

With reference to the Notification of the Government of India, Public Works Department, dated the 12th October last, Mr. A. H. C. MacCarthy, Assistant Engineer from the Royal Indian Engineering College, who reported himself at Calcutta on the forenoon of the 26th November 1888, is posted to the Sone Circle.

Mr. O. C. Lees, Executive Engineer, reported his return from furlough on the forenoon of the 11th December 1888, and is posted to the South-Western Circle.

## Indian Engineering Patent Register.

The 7th December 1888.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act V. of 1888, in the Office of the Secretary to the Government of India in the Revenue and Agricultural Department:—

31 of '88.—Adam Moszozensky of 24 Twelfth Line Ismailsky Polk, St. Petersburg, Russia, Count of the Russian Empire.—*For manufacture of refractory crucibles, pots, bricks and lumps for furnaces.*

70 of '88.—A. Rogers and J. Nagona, the former of Saharanpore and the latter of Dehra Doon, East India.—*For a share to fit the native plough in British India.*

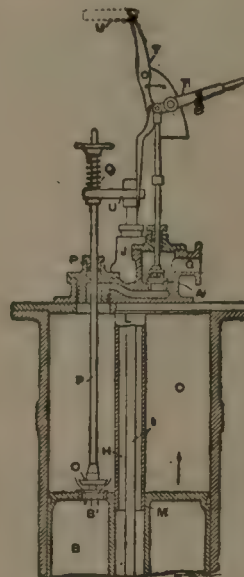
102 of '88.—William Crookes of Kensington Park Gardens, London, England, Gentleman.—*For improvements in the treatment of auriferous ores and in the revivification of the materials used in such treatment.*

107 of '88.—Thomas Gilbert Bowick of Harpenden, in the County of Hertfordshire, England, Chemist.—*For an improved process and apparatus for purifying alcohols by means of hydrocarbons.*

117 of '88.—Alfred Savill Tomkins of Holmwood, Caterham, in the County of Surrey, England, Captain in the Victoria Rifles.—*For improvements in portable cooking apparatus.*

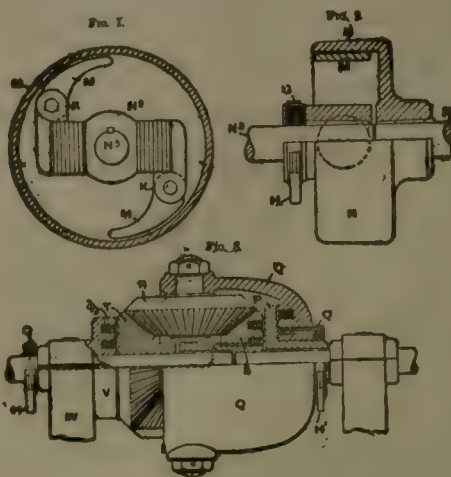
#### BRITISH PATENTS.

STEAM PUMPS.—*J. Tanguy & R. J. Connock, Redruth.*—A considerable loss of power is usually involved by bringing the steam into contact with the cold surfaces of the cylinder. The object of this invention is to heat these surfaces by means of the exhaust steam as it issues from the motor cylinder. The figure shows a section of part of the steam cylinder which is built upon the improved lines. The cylinder C is twice the length of the working stroke of the piston.



The bottom of the cylinder is connected to the pump column, between the suction valve and delivery valve. The hollow piston works in the cylinder B, and is of a length rather exceeding that of the working stroke. The exhaust steam, at the completion of each stroke, enters the piston on its way to discharge, and imparts its heat to it. A pipe L opening into the pipe K surrounds the piston rod I, and opens at the top into a bend J leading into the outer air. The steam gets into the piston through O, and leaves it for L through holes at the bottom of B. The exhaust O opens and closes a passage B<sup>1</sup> in the piston B, and is actuated by a rod P, and by the trip gear T U Q. Four claims are made for the combination of the hollow piston through which the exhaust steam passes, and escape pipes from the hollow piston to the outside of the cylinder.—No. 11970. September 3rd, 1887.

FRICTION CLUTCHES GOVERNED BY ELECTRICITY.—*J. S. Raworth and H. M. Sayers, London.*—The power for bringing the friction surfaces into contact is obtained from an electromagnet either directly or through the instrumentality of levers or screws. A form of plain coupling with hinged electromagnets is illustrated in Figs. 1 and 2. The plain bored ring N is carried on a shaft N<sup>1</sup>, and a plate N<sup>2</sup> is fixed on the other shaft N<sup>2</sup>; the electromagnets M are attached to this plate by the hinges K. On a current being passed through the magnets they are attracted to the iron ring N, and the driving connection is complete; when the electric connection is broken the magnets are removed from the ring by means of springs. Fig. 3 represents a geared coupling for transmitting power from one shaft to another.

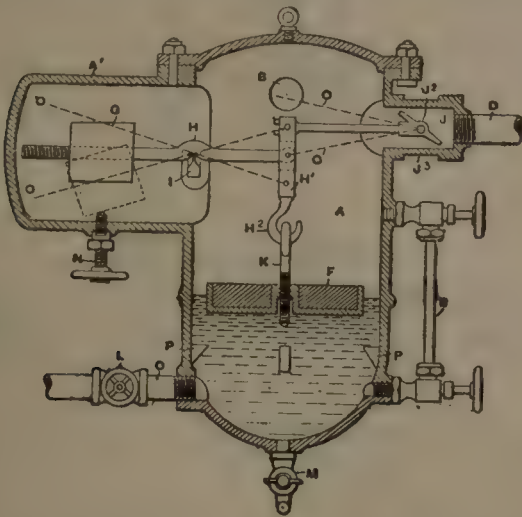




at a different speed. The plate P is keyed to the driven shaft, and is able to move longitudinally on it. The case Q carries two loose wheels R, and runs loosely on the boss of the plate P. The wheel S is keyed to the driving shaft, and the wheel T runs loosely on the same shaft and forms the fulcrum wheel. The plate V is attached to the side of the bearing W, and grooves, which are fitted with conductors, are provided in the plate V, the wheel S, and the case Q. The rubbing contacts G H and G<sup>1</sup> H<sup>1</sup> are respectively provided for the wheel S and for the case Q; the plate V is stationary and does not require rubbing contacts. When the driving shaft revolves and no current is passing, the four wheels S R R T revolve without imparting motion to the driven shaft. When a current is sent through the contacts G<sup>1</sup> H<sup>1</sup>, the case Q will be attracted to the plate P; and on sending a current through the conductor in the plate V, the fulcrum wheel T will be stopped and the driven shaft will revolve at half the speed of the driving shaft. By cutting off the current in V and sending it through the contacts G H and the wheel S, the whole arrangement becomes a plain coupling, and the two shafts will revolve at the same speed. Four claims are made for a friction coupling governed by electricity, in which the electric conductors are contained in a groove or grooves in the face of the coupling, for combining the parts so that the two shafts can be made to revolve at different speeds, and for the methods for carrying these out, as described—No. 11091. August 13th, 1887.

#### RECENT AMERICAN PATENTS.

**FED WATER REGULATOR.**—O. Inray, London. (F. Cook and B. Thoens, New Orleans, U. S. A.)—The automatic apparatus for regulating the supply of water to a boiler in order to maintain a constant level is illustrated in vertical section in the accompanying figure. The upper part of the closed vessel A is connected with the steam space of the boiler by the pipe B, and the lower part communicates with the water space through the pipe C. The pipe D allows the steam to pass to a feed pump which forces the water into the boiler. The glass E indicates the level of the water. A lever H is mounted on the knife edge I, and the two ends of the lever carry the weights F and G. When the vessel is empty the weight F descends until it rests upon the stops P, and in its motion up and down it closes or opens the valve J, which controls the flow of steam through the pipe D to the feed pump. The chamber J<sup>a</sup> is of greater diameter than the pipe D,



so that a slight alteration in J shall have a considerable effect on the steam supply. The rate of supply of water to the boiler can be varied by adjusting the counterweight G to different positions along its lever, and the water level can be altered by screwing the weight F higher or lower upon the rod K. When it is desired to pump up the boiler before blowing off, the valve L is closed and a cock M at the bottom of A is opened so as to allow some of the water to escape. This causes the weight F to descend and to open the valve J, so that the feed pump runs faster and fills up the boiler to the required height. In order that the feed pump may never be so far retarded as to be liable to stop at a dead centre, an adjusting screw N is set as a stop for the counterweight. The weight F is preferably made of hollow metal filled with stone or cement so as not to be so much heavier than the water. One claim is made for this apparatus.—No. 8633. June 12th, 1888.

## Advertisements.

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## IMPORTANT NOTICE.

All Civil Engineers of the Department are informed, that, owing to the extended support accorded to the Civil Engineers' Association, the Committee feel it necessary to still further widen their sphere of influence, and to delegate some of their duties.

The current work has been entrusted to Local Sub-committees, who will correspond with the Central Committee.

Every Civil Engineer is urged to write to the Hon. Sec. c/o Grindlay, Groom and Co., Bombay, who will put him in touch with his Sub-committee, with the view of enrolling him a member of the Civil Engineers' Association.

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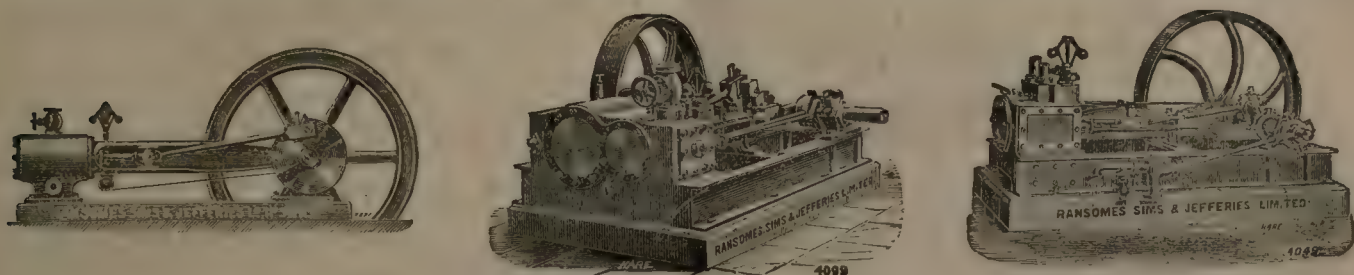
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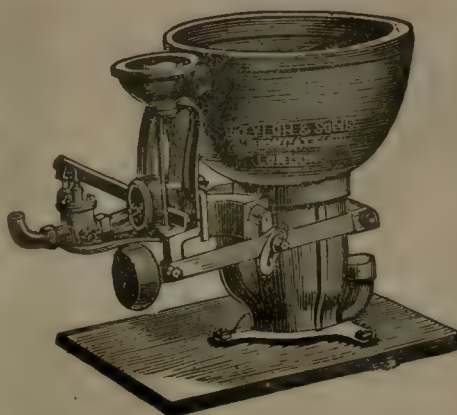
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FIRE DEPARTMENT.		LIFE DEPARTMENT.		MARINE DEPARTMENT.	
Premiums after deducting		Premiums after deducting		Premiums after deducting	
Re-insurances	... £769,265 0 0	Re-insurances	... £125,559 0 0	Re-insurances	... £175,118 0 0
Interest	... £ 19,612 0 0	Interest and Dividends	... £ 45,649 0 0	Interest	... £ 8,294 0 0
Losses after deducting Re-insurances	... £443,587 0 0	Claims less Re-insurances,	£ 79,229 0 0	Losses after deducting Re-insurances	... £138,365 0 0
				Interest not belonging to above, but included in Profit and Loss	... £ 18,545 0 0

The Life Fund was increased during the year by £65,648 and now amounts to £1,070,064.

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the uncalled Capital of £2,250,000.

The rates of Premium are moderate, but they are not unsafely low, and will be found to stand the test of time, thereby in conjunction with the ample Funds affording absolute security to the assured.

The Total Funds and property in hand on 31st December 1887 stood at £2,613,059.

(39)

C. H. OGBOURNE, *Manager and Underwriter.*

## PURE HYDRAULIC LIME. FREE FROM ADULTERATION.

Numerous favourable certificates of the quality of our manufacture have been received, and the following are fair selections:—

J. H. APJOHN, Esq., Superintending Engineer, Kidderpore Dock Works, says:—

"Mr. McKennie's test for purity applied at Raneegeunge shewed that it contained only 22 per cent. of insoluble matter, or only 3rds of the impurity allowed; there can be no question but that it is of very superior quality."

PAUL DEJOUX, Esq., Executive Engineer, Government Cement Experiment Division, reported:—

"It is the best Ghooting Lime imported into Calcutta."

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"It has been for long past and is now invariably used in all works, particularly drainage works. I have much pleasure in certifying to the excellent and reliable quality of the Lime."

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N.P.—Our Lime was used throughout all the River Works of the Calcutta Port Commissioners.

## BURN & CO.,

(179)

7, Hastings Street, or Raneegeunge.



## Notices.

The Office of Publication of *Indian Engineering* is at the "STAR PRESS," 19, Lall Bazar, Calcutta.

General correspondence, and all communications bearing upon literary matters, should, as heretofore, be addressed to PAT. DOYLE, C.E., Spence's Hotel, Calcutta.

It is particularly requested that all letters on business concerning subscriptions and advertisements be addressed to the "Managing Agents," MESSRS. BALMER, LAWRIE & Co., 103, Clive Street, Calcutta; and all remittances be made payable to them.

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An allowance is made for continuous insertions.

## NOTICE TO ADVERTISERS.

THE scope of this Journal makes it aspire to become the only thoroughly useful and trustworthy means of communication between the Profession and those who supply its wants. It should prove useful alike to users of machinery, engineering and building plant, or materials, and to the engineering trades generally, including manufacturers or importers in this country.

An object has therefore been to obtain for its columns special recognition as the best medium for ENGINEERING ADVERTISEMENTS in India. We use the word "India" advisedly since our circulation is not confined to any particular locality or province, but is pretty equally distributed all over the country.

It is hoped that the Profession will utilise the Journal more largely for making known its requirements, and the Editor's co-operation may always be relied on, should it be needed, for such purposes.

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## Obituary.

KNOWLES.—November 25th, at Koraput, Vizagapatam Agency, W. Knowles, Assistant Engineer, D. P. W., aged 27 years.

### ANSWERS TO CORRESPONDENTS.

"R" makes an Enquiry and offers a Suggestion, but forgets to authenticate his communication.

# INDIAN ENGINEERING.

SATURDAY, DECEMBER 22, 1888.

## NOTES ON TECHNICAL EDUCATION.

MR. ROBERT FELLOWES CHISHOLM, F.R.I.B.A., has put forth in pamphlet form some excellent *Notes on Technical Education*, addressed to H. H. the Gaekwar of Baroda, who is complimented on his enterprize and liberality in the prosecution of extensive and costly public works, since these are indubitably the best schools possible for perfecting Arts and Manufactures. The Muckrapura and Luxumi Villa Palaces have, we are told, been the means of attracting to Baroda craftsmen of all kinds, and of securing a finish superior to anything hitherto achieved in Mofussil India, and "the spirit thus introduced carried throughout portable crafts for exportation, cannot fail to lay in Baroda the foundation of an important manufacturing centre." Seeing is the best of all believings from a technical education point of view. Mr. Chisholm is of opinion that a Workmen's Institute can be established, and the training of artisans accomplished without any difficulty, in Baroda. Also that a more rigid and systematic course of hand and eye culture can be gradually introduced in the College curriculum. He suggests that in connection with the Workmen's Institute there should be a Museum and Picture Galleries. The leaded glass windows manufactured in Baroda would find a ready sale outside its limits, and the scope of the manufacture only fails to advance because the artisans in Baroda cannot draw. Meanwhile, the best arabesqued windows executed have been designed by plasterers who "learnt to draw laboriously with a trowel," and so were able in some sort to work up in plaster Mr. Chisholm's rough sketches. Here is evidently talent, only needing to be instructed as to proper methods for its application.

We agree altogether with our author that it is a pity Technical Institutions should at the outset fall into the hands of mental educationalists, too many of them absolutely devoid of eye and hand culture, and "as incapable of giving unselfish sympathy to the movement as a man devoid of ear is of whistling the simplest tune." Here is a paragraph worth thinking about :—

"It is not a matter for wonder that a workman with a perfect knowledge of his craft, reflecting on the means by which that knowledge was gained, should smile at the professor of the modern Technical Institute. On the other hand, we have evidence indisputable that the workmen in those countries wherein Technical Institutes have been founded, have a more extended knowledge of various crafts, and although their actual work may not at the present moment be superior, it is unreasonable to suppose that this greater mental breadth will not make itself felt Internationally, that all other things being equal, the Nation whose workmen are intellectually superior will produce higher class and consequently more valuable work."



However good, however useful Technical Institute training may be, we must not allow ourselves to be run away with by the idea that it can ever be a perfect substitute for the apprentice system. Its aim should be to supplement, not to supplant. Again we quote some of Mr. Chisholm's pertinently suggestive remarks:—

"Let us understand in the first place the actual condition of Art Industries in India. Sir George Birdwood has, doubtless with the most laudable intentions, put a glowing picture of Indian art industries before the world which is apt to be misleading. With the exception of the 'historical glazed earthenware of Madura,' which does not and never did exist, he gives a perfectly true account, but the glowing colors and poetic imagery lead to impressions so amusingly wide of the mark, that I have met not a few tourists armed with his book, highly indignant that their search for articles in industrial centres should have met with so little success. The fact is that with the exception of cotton spinning and a few such industries which may be counted on the fingers, there is absolutely no art industry in India. The country teems with *industrial artists* of all kinds who produce manufactures of a high order, and this aptitude may hereafter be a source of national wealth, but the works of these artists could no more be called, or ever become, industries in the Western sense of the term, than could the original paintings of any special artist in the West. To form an industry combination and capital are essential, and these can scarcely be said to exist in India among the artisan class."

Mr. Chisholm deprecates equally attempt to turn artisans into B. A's. or otherwise well-to-do people into artisans. In India we have to *create* industries, and this is hardly to be done by throwing a number of half taught and consequently conceited art workmen on the market—men who, measuring their executive skill by their *knowledge*, would be wholly unable for want of practice to take the place of the present operatives. The Victoria Institute is said to be besieged by applicants. But, says Mr. Chisholm, cautiously and sagely this is in no way a proof of its success, for we knew that at first the Institute must be a veritable refuge for the destitute, a new field opened out for all who are too stupid, too lazy, or too poor, to go through other courses of study, and if the Government provided and endowed an institution for the training of circus riders, or the higher education of aëronauts, it would be similarly besieged.

Technical Institutes, art teachings of all sorts must appeal to, must have application to the artisan classes if they are to fulfil their purpose, and do good work in the world. We want to influence not academically trained embryo philosophers, not M. A's. and B. A's. but the more or less educationally callow sons of carpenters, wood carvers, stone cutters, jewellers, and other art craftsmen; men whose eyes and hands are already in a certain state of grace because of the virtues of heredity, and who are therefore likely to prove receptive to the dictates of formulated art education. Mr. Chisholm is

of opinion that in order to get at this class it will be necessary to provide special means of training—training in an Industrial Institute in this country being likely to fill them with ideas beyond those of artisans. He says:—"Personally I look upon these undertakings as another instance of taking an Eastern short cut to Western Civilization by direct imitation, instead of patiently plodding the roads which lead to the goal—teaching running before walking!"

He would prefer to have National characteristics conserved. So should we; any other plan must result in more or less of caricature and feebleness. And the exigencies of the time and the right demand more than anything else of utility. That is the god to which flatulent young India should turn its worshipful regard. Conserve what is good in indigenous art; but by all means get rid as speedily as may be of the many elements of bad inherent in it, pertaining to it.

What is required, and what we must admit to be extremely difficult at the present moment to obtain, is a staff of hand and eye tutors, men capable of teaching hand and eye culture systematically, men who will not accept inaccurate work on the technic side any more than teachers accept inaccurate work on the mental side, men who would properly regard the statement that 8 times 7 or 8 times 8 are *about* 60, as valueless.

A central Workmen's Institute with a small museum of appliances is approved of; and it is suggested that all recognized craftsmen should be invited to become members thereof, and effort made to unite the class into a kind of guild. Initially the Institute will have to be established by the State, and should not cost more than from 15 to 20 thousand rupees, which might be repaid by instalments. Every village might in time possess its Workmen's Club or Institute. But, says the pamphleteer, when all this is done "something still will remain to be done, before the art industries of India can be made to compete successfully with the West. What I did in the matter of potting bodies and glazing in Madras, must be done in every branch of art industry, it consists of supplementing the manual dexterity of the native by known processes of the West.

Mr. Minton, the eminent potter, admitted that Mr. Chisholm's throwers and turners were as expert in short bodies as the Staffordshire men, but of what use would this expertness be if these same throwers were ignorant of the processes by which cups and saucers are made.

As a teacher, some particular skilled workman should be obtained from Europe every year, for six months only. The order in which the services of these practical teachers should be secured would be decided by the particular works in progress at the time. Here, our author says, is a possible sequence:—

1. Carpenter and joiner.
2. Painter and glazier.
3. Decorator.
4. Stone curver
5. Plumber.



and those should be followed by higher artisans :

6. Potting foreman.
7. Superior wall decorator.
8. Glass blower.

The space at our command has allowed us to do but meagre justice to Mr. Chisholm's very valuable and interesting "Notes." We heartily recommend all our readers to get a copy of his pamphlet, and to digest it. The matter of Technical Education is one of yearly increasing importance and imperiousness.

#### MADRAS P. W. D. ADMINISTRATION.

A CAREFUL examination of the Administration Report of the Public Works Department, Madras, shews that they do their work better in the so-called Benighted Presidency. The economical way in which the affairs of the Department is managed elicited well-merited encomium from the Supreme Government. In the beginning of 1887 the Madras Government was called upon to frame a careful estimate of the Engineer and Upper Subordinate establishment consistent with efficiency of the work required to be done by them. The way in which expenditure had been reduced was so satisfactory that the Government of India could suggest nothing more in that direction, and the order for reduction in the Engineer grades had to be abandoned. But they thought that the establishment of the Upper Subordinate grades might be somewhat modified by introducing instead Lower Subordinate agency in certain cases. The Chief Engineer was entrusted to look after this ; there was, however, some doubt whether it would be desirable to place officers of the lower grade in the large and responsible charges generally held by Upper Subordinates ; the Government of India has ruled that any Civil Engineer of the Department who did not attain the rank of Superintending Engineer on reaching the age of 50 would be liable to be retired either immediately or within a specified period, according to the length of service, with the privilege of going on furlough prior to retirement.

Nearly 39 lakhs of rupees were the total expenditure actually incurred under the different service heads ; the Provincial Civil Works absorbing almost half of that amount, *viz.*, Rs. 19,42,590, exceeding even the revised estimate by Rs. 30,000.

The Harbour works came in for a good deal of attention. Observations having been taken of the effects on the works there of the cyclone which passed near Madras at the end of 1887, Captain Taylor, the late Port Officer, arrived at the conclusion that the only way in which smooth water could be secured was to close the eastern entrance. He suggested that an opening be made at the north-east corner, protected by an extension of the outer sea-wall in a northerly direction. Great benefits are expected to result from this arrangement. On the scheme being submitted for the sanction of the Secretary of State for India, a Committee was appointed at Simla to consider the question in all its bearings. After several consultations the Committee pronounced in favor of an

entrance at the north-east corner with a covering arm, the entrance on the east face being closed up. The expenditure on the works was Rs. 3,92,718, and the total expenditure from the commencement of the works was Rs. 24,24,930, against the sanctioned estimate of Rs. 45,90,051.

The proposals for improving the water-supply at Bangalore were considered during the year under review. The scheme only related to potable water, while for other purposes the Hulsur tank-supply was to be improved. The works of the former were estimated to cost Rs. 2,26,860, in addition to an annual charge of Rs. 84,600 for maintenance of distilled water system, and Rs. 27,000 per annum for the Hulsur tank-supply. The Government of India, in view of the enormous expense of the dual system of water, have viewed the project with disfavor, and have expressed a hope that further investigation might show that a satisfactory supply could be secured involving less annual expenditure.

In connection with the Ootacamund water-supply, the pipes were, in the first instance, jointed with Portland cement, but this was not satisfactory and subsequently lead had to be used. By the end of the year the works will be completed. The expenditure during the year was Rs. 31,927, and the total expenditure from the commencement was Rs. 1,43,012, against the sanctioned estimate of Rs. 1,70,000.

The subject of providing new buildings for the local High Court had been brought to the notice of Government so far back as 1875, but the matter remained in abeyance till 1884, when it was once more mooted, and a Committee was appointed with the Chief Justice of Madras as Chairman to report on a site best suited for the purpose. The Committee reported that "of the open sites in the town, *the site on the Esplanade north-east and north-west of the lighthouse would be the most convenient for the public, if there was no objection on the part of the Military Authorities.*" The latter, however, objected, and it was ultimately decided to dispose of the present site and buildings and to erect the new High Court premises near the lighthouse, as it was the only suitable one. Plans and estimates are being made with this view.

The opening balance of Presidency Public Works Stocks stood at Rs. 2,07,438 and the issues to the various departments were valued at Rs. 52,181. The year closed with a balance of Rs. 1,75,494, being Rs. 31,944 less than the opening balance.

For "Agricultural" works the original grants were Rs. 79,000 under ain, 17,000 under devastanam, and 4,000 under chutrum. The revised grants were Rs. 59,366, 9,712, and 4,427, while the expenditure amounted to Rs. 43,626, 1,874, and 1,142, respectively, showing a total short outlay of Rs. 20,863 in connection with the total revised grant.

The Court Houses and Police Stations in Madras seem to be in a bad way altogether. The necessity for a new building for the Presidency Magistrate in Black Town, has long been felt, but the same difficulty, as in the case of the High Court, has been a stumbling block in the way of erecting new premises ; it seems, however, the obstacle



has been removed by selecting a site on the beach to the south of the Telegraph Office, which is considered to be an eligible situation. Expenditure to the extent of Rs. 49,830 has been sanctioned for the erection there of a Court House, a Police Station, and Fire-engine Room combined. The work was commenced at the close of the year.

In the matter of additions to the Madras College of Engineering, it was delayed owing to the non-arrival in time of girders from England, and the faulty cast-iron columns made for the ground floor. One of these parted, and on examination several others were found defective; so to avoid any risk some were placed in position to carry lighter loads, and stout columns substituted for others. The expenditure during the year was Rs. 37,946, and the total expenditure Rs. 67,228 against the estimate of Rs. 90,066.

Estimates to the extent of nearly Rs. 33,000 have been submitted to Government in connection with improvements to the Lawrence Asylum, Ootacamund. The improvements concern mostly the hospital wards and a water-supply scheme. There is also a project for enlarging the girls' school to accommodate 25 more girls. The approximate cost is Rs. 20,000. The local Government are of opinion that a single hospital, the cost of which is set down at Rs. 18,000, is preferable to a cottage for infectious diseases at Rs. 14,000, together with another sum of Rs. 2,000 for repairs and alterations to the main building. The proposals for enlarging the girls' school was, however, allowed to drop, as there are no funds available for the purpose. In case the water-supply scheme is approved, it is proposed to apply to Government of India to allot funds, as a special case, for its execution from the Military Works grant.

The value of machinery in the Presidency Public Works shop on the 31st March last official year, was Rs. 1,05,825, and at the end of the year under review it was Rs. 1,07,945. The balance of materials on hand was found to be represented by Rs. 25,025, being Rs. 4,023 less than the figure shewn on the 31st March 1887. The opening balance of stock in the beginning of the year was Rs. 2,07,438, the receipts during the same period were Rs. 20,236, and the issues valued at Rs. 52,181. The year, therefore, closed with a balance of Rs. 1,75,494, or Rs. 31,944 less than the opening balance.

**COST OF COKE PRODUCTION IN ENGLAND.**—An American paper gives the cost of production at Durham, the leading coke centre of England.

Labor of mining and putting into trucks, per ton of			
of coal, about ...	...	...	\$0.51
Other charges, about ...	...	...	0.14
Royalty, about ...	...	...	0.14
Total ...	...	...	\$0.79

There is realized from 1 ton of coal 60 to 62½ per cent. of coke, so that the cost per ton of coke is—

1½ tons of coal ...	...	...	\$1.32
Cost of coking ...	...	...	0.24
Labor in drawing and filling, preparing, including putting on board car ...	...	...	0.24
Total ...	...	...	\$1.80

The present price at Durham on board cars is about \$1.94, so that the operators in that locality seem to be but little better off as regards profits than those at Connellsville, where the price, however, for new contracts is \$1.25. We shewed by our former figures that the cost of production at the latter place is now \$1 to 1.20 per ton of coke on cars. In mining, the natural advantages are on the American side, where the coal seams are about 8 feet thick, against 4 feet in the Durham coking collieries.

## Notes and Comments.

**KURNOOL CANAL.**—The purchase value of this white elephant, as shewn by the facts and figures given by us in a recent issue, is Rs. 2,16,44,795.

**COMING LEGISLATION.**—It is said that the Cantonment Bill will come before the Select Committee of the Legislative Council early in January, the Merchandise Marks Bill towards the end of January, and the Railway Bill in February.

**GOOD NEWS FOR THE CALCUTTA ENGINEERING TRADES.**—It has been decided to abolish the Government Workshops at Seebpore, and the Burrakur Iron-Works will no longer be permitted to undertake *private* work as the advertisement in the public press is said to imply.

**THE C. E. ASSOCIATION.**—An Address was presented to Lord Lansdowne by the English Secretary of the Civil Engineers' Association, shewing some of the disabilities C. E.'s. suffer under in the P. W. D. His Excellency promised to give "careful attention" to the subject.

**FLOATING PLANT OF THE KURNOOL CANAL.**—The annual upkeep of the staff, passenger and cargo boats on this waterway costs nearly Rs. 2,000. The boats are only used for departmental purposes, some being used for carrying materials and others rented by the officers in charge.

**THE BURRAKUR IRON-WORKS.**—We learn that a valuable find of coal has been made on this property of Government, which will go far to enhance the marketable value of the concern in a very high degree. Of course, there is no intention to work this coal, but it is well to know that it is there.

**PUNJAB MAIL SERVICE.**—The Lahore paper complains of the constant mismanagement which prevails in connection with the Railway Mail Service for the Punjab. That paper is not in a position to say whether the Postal Department, or the North-Western or any other Railway, is to blame for this scandalous state of things.

**"PRIVATE AND CONFIDENTIAL."**—There can be no justification, morally or otherwise, to publish, as was recently done by a would-be Professional organ, private correspondence from the Secretary, C. E. Association, to individuals—the said correspondence being only printed to save the labor of writing, and not therefore the less addressed to individuals.

**PROSPECTS OF THE BURMA RICE CROP.**—The report up to 30th November 1888. The area under rice cultivation is now reported to be 99,657 acres, or 3 per cent. more than the actual area under cultivation last year. In spite of the poor crop in Akyab it is estimated that there will be available for export 1,121,000 tons of rice including what will be required for Upper Burma.

**ADJUSTMENT OF RANK.**—We observe the following intimation in the *Gazette of India*:—Sub-Conductor James Tuck Military Works Department, to be a Deputy Assistant Commissary, *Supernumerary*, with effect from the 11th April 1888, and to stand next above Deputy Assistant Commissary and Honorary Lieutenant James McCauley. Perhaps some of our readers may be able to explain what this signifies.

**THE INDIAN MIDLAND RAILWAY.**—The first train was piloted over the Singh Bridge, half way between Jhansi and Gwalior, on Tuesday morning. As the Antri cutting has been cleared out, all is now plain sailing into Gwalior,



and it is perfectly certain that the line will be ready for opening early in February. The final inspection of the Bhopal line by the Consulting Engineer to Government has been made.

**COLONEL LUARD, R.E.**—This officer returned to India by the mail that arrived in Bombay on the 11th instant, and has, we hear, taken up the Senior Consulting Engineer-ship (under the Government of India) relieving Colonel LeMesurrier, R.E. The question now exercising the upper circles of the Department is—what will become of the latter? The only answer we can suggest is—put him on special duty!

**OUR BURMA ITEM.**—Mr. Ring, on his return from furlough, has been appointed Superintending Engineer, 3rd class, temporary rank, and is appointed to the charge of the III. Circle in Upper Burma. His head-quarters is Mandalay. Mr. Richard, who has just given up charge of this Circle, may likely be appointed Superintendent of Works, should an additional Circle of Superintendence be sanctioned for Burma.

**BOMBAY MUNICIPAL BUILDINGS.**—Mr. F. W. Stevens will leave England on the 7th February, bringing with him the completed plans for the new Municipal buildings. The plans in question will be on view in Bombay at the beginning of March. Good judges who have seen the designs speak very highly of them, and are of opinion that they will add even to the reputation of the architect of the Victoria Terminus.

**BENGAL P. W. D.**—Mr. T. Haines Wickes, who has returned to the Presidency from deputation to the North-West Provinces, has taken over charge of the office of Superintending Engineer of the Western Circle from Mr. H. Joll. Mr. Joll has assumed charge of the Superintending Engineer's Office, Eastern Circle, from Mr. W. H. Nightingale, who returns to his permanent appointment as Inspector of Local Works, Bhaugulpore.

**THE PANAMA CANAL.**—Count de Lesseps, in spite of his oft-repeated promise, is not likely to open the Panama Canal in 1890. He has resigned the Chairmanship of the Company, leaving the work of cutting the Isthmus, which was begun in 1881, less than half done, and the Company with its capital of £24,000,000 in liquidation. It can scarcely be said, however, that the financial embarrassment into which the Canal Company has fallen has been unexpected.

**ITEMS FROM BOMBAY.**—Mr. John Wallace, C.E., writes to us:—I send you herewith a short account of the starting of the first triple expansion land engine in India, which may perhaps interest your readers. The dynamometer experiments have been laid aside through press of other work. They are on hand again, and I shall shortly send you a set of diagrams and a photograph of the instrument. We hope to present the first communication in an early issue.

**MICA MINES IN HAZARIBAGH.**—The Government of Bengal has now issued separate rules for the grant of leases to mine for mica in the district of Gya and Hazaribagh. The following facts are published for general information:—"The mica found in Hazaribagh and Gya on Government estates occurs irregularly and precariously in a coarse variety of granite. Its presence in plates of the size and colour required can be ascertained only after careful examination and experiment by way of prospecting.

**P. W. D. REDUCTIONS.**—We learn that a list of 100 men—10 per cent. of the present establishment—has been prepared by the Government of India, of men who are to be called upon to retire, both on account of recognized inefficiency, and under the 50-year rule. We have not heard how the retirements are to be enforced, nor whether any compensation is to be given. It would appear that the Government itself is uncertain as to the course it will adopt, and its action in this matter is enveloped in mystery and ambiguity.

**A NEW AUDIT SYSTEM.**—Major LeBreton, the Examiner of Public Works Account, Bombay, has introduced a new system of auditing accounts in that department, and a committee consisting of Mr. T. D. Little, M.I.C.E., Superintending Engineer, N. D., Khan Bahadoor M. C. Murzban, A.M.I.C.E., Executive Engineer, Presidency, and Mr. Lund, Deputy Examiner of Public Works Accounts, has been appointed by Government to report on the new system of accounts, and how it could be extended so as to reduce clerical and audit work.

**THE INDUS BRIDGE AT SUKKUR.**—This bridge will probably be opened in March next. Up to date both the cantilevers are erected, with the exception of the last bay, and now stretch 267 feet over the water. The suspension staging for the erection of the central 200 feet girder has arrived. The wire rope overhead gear has worked wonderfully well and gives no trouble. No. 1 strut was lifted whole from off the barge and put into its place with the overhead gear: the time occupied in lifting each strut being three-quarters of an hour.

**JUBBULPORE TRAMWAYS.**—Arrangements are in progress for the construction of tramways in Jubbulpore; in fact, Messrs. Sibold and Williams' contract with the Municipality has been signed, sealed, and delivered, and the work is about to commence, if it is not already begun. In this connection it is mentioned that Nagpore has no need of a tramway. The native city, though thickly populated, is not of great dimensions, and, moreover, even the principal streets are too narrow to admit of rails being laid down in the centre.

**HOWRAH STRAND ROAD.**—Calcutta and Howrah folk will be glad to hear, that work is to commence immediately on the foreshore road from Shalimar Point to the Royal Botanical Gardens, and it is to be hoped will be completed before the 31st March. When completed and well lighted, the Howrah Strand should compare favorably with its rival on the opposite bank, and the drive to the Royal Botanical Gardens would be more enjoyable, as compared with the drive through the narrow and crowded thoroughfares of Ramkistopore and Seebpore. The work is to be carried out by the P. W. D.

**"A GRAND STRUCTURE AND A TRIUMPH OF ENGINEERING SKILL."**—A contemporary hopes that the ceremony of the opening of the bridge over the Indus at Sukkur will be worthy of the occasion, for the bridge boasts the biggest span in the world, and will only be eclipsed for some years to come by the Forth Bridge when that is finished. The same paper adds that the Sukkur Bridge has been many years under construction, and its early history is not altogether a pleasant one to study, as it is a record of battles over sites and plans; but it is a grand structure and a triumph of Engineering skill.

**LIEUTENANT-COLONEL A. C. BIGG-WITHER.**—We are able to announce that it has been definitely settled that this officer returns to Bengal. A Superintending Engineer-



ship will have to be provided for him, as he is senior to several officers now holding that rank. Lieutenant-Colonel Bigg-Wither is one of the most earnest workers, and whatever else may be said, there is no doubt as to his remarkable capacity for pushing on work. He is a Bachelor of Arts, and an Associate of King's College, London: is borne on the General List Infantry and passed an excellent examination out of Roorkee, being at the head of his year.

**THE KOLAR GOLD MINES.**—The quantities of ore crushed and gold obtained at the five Kolar mines last month is as follows:—Balaghat, one hundred and forty tons, two hundred and two ounces; Consolidated, five hundred and fourteen tons, one hundred and nineteen ounces; Mysore, fourteen hundred and seventy-seven tons, twelve hundred and fourteen ounces; Nundydroog, four hundred and eight tons, seven hundred and fifty-seven ounces; and Ooregum, three hundred and eighteen tons, six hundred and twenty-two ounces. Mysore also obtained one hundred and nineteen ounces of gold from five hundred and fourteen tons of tailings.

**ROAD CESS OPERATIONS IN CHUTIA-NAGPUR.**—Out of the total disbursements in the Division last official year, Rs. 1,10,843-0-7 were spent under the head of "Repairs," and Rs. 12,167-11-4 on "Original works." Village roads in the districts of this Division have been maintained so far as funds permitted. Attention has been given by every District Committee to arboriculture. New trees have been planted along roadsides, and those planted in previous years have in most cases been maintained. The subordinate establishments of the different departments of the Road Cess office are reported to have given satisfaction in the discharge of their respective duties.

**KIDDERPORE DOCKS.**—From the report of the sixth quarterly inspection of the Kiddepore Dock works, acknowledged in our last, we find that the total expenditure during the period under review was Rs. 1,08,47,709, of which Rs. 84,32,350 were spent on account of works, and Rs. 24,15,359 for land. Considering that heavy rain fell during the latter end of August and in the beginning of September last, which retarded the prosecution of the works, fair progress had been made with them, and their character was satisfactory. The health of the workmen was very fair. The average number employed was 9,151, among whom there was a death-rate of only 12·1 per thousand per annum.

**WANTED A HEALTH OFFICER.**—The Poona City Municipality lays down the following liberal conditions for a Health Officer:—1. He must be a graduate of a University in Medicine. 2. He must possess experience in Sanitary matters. 3. He must bind himself to serve the Municipality at least for three years, for the first of which he will be on probation. 4. He must furnish security to the Municipality in the amount of Rupees two thousand (Rs. 2,000). 5. He will not be allowed private practice. 6. The Salary will be Rs. 150 per month at the beginning, rising to Rs. 200 per month, at an yearly increment of Rupees ten (10). What have our English readers got to say to this?

**SECUNDERABAD DRAINAGE AND WATER-SUPPLY.**—The estimated cost of the drainage project is Rs. 90,000. The cost of the water-supply is four lakhs. Major Fox, Executive Engineer, has drawn up both schemes. The drainage works will be undertaken first. He proposes to construct a channel, for the purpose of carrying off the

whole of the surface drainage, which at present flows from the town into the Hussain Sangor tank, and in providing in the bed of this drainage channel an open sewer, which will receive all the town sullage, which also now flows into the tank. The sewage will be discharged into a nullah which leads from the waste weir of the tank to the mossy river.

**CENTRAL ASIA ITEMS.**—The section of the Central Asian Railway from Samarkand to Jizak, which has been under construction for some time has, we learn, now been opened for traffic. Jizak is 21 Bokhary farasangs from Samarkand.—The Shah of Bokhara has, on the suggestion of Russia, recently constructed two regular cantonments for troops. One at Darwazai Nimazgah, and the other at Bahaud Diu.—News received from Chitral states that, owing to an excessive fall of snow at Kotal Duraj, the road from Chitral to Badakshan has been closed. Aman-ul-Mulk has detailed 600 men under Sher Bacha Khan to remove the snow, in order that the caravan traffic may be resumed.

**THE DELHI-KOTRI RAILWAY.**—We understand that an examination is now being made of the country between Bikanir and Jeysulmir, but that the country through the Sind desert is so hopelessly bad either *vid* Khipra or Omercote, that a line could only be kept open under very costly conditions of both construction and maintenance. As it is very unlikely that the Government will give a guarantee to a company for the making of this line, shorn as it now is of the Delhi-Kalka section, the project may, we think, be considered as shelved, at any rate during the present century, and Kurrachee must find its account through its present channels of communication for some time to come.

**RE GENERAL RICHARD STRACHEY, R.E.**—Those who remember the evidence given before the Special Committee on the Hyderabad scandal by General Richard Strachey, R.E.,—often confounded with his civilian brother Sir John—will hear without astonishment (says the *Pall Mall Gazette*) that in well-informed quarters he is reported to have been the principal agent in leading Viscount Cross astray in regard to the Burma Ruby Mines. As in India, so in England, the name of Strachey seems destined to be associated with grave official errors. The break of gauge and the Budget blunder are not inadequately matched by the Deccan Mining Concession and the treatment of the Streeter Syndicate. *Caelum, non animum mutant, quitrans mare currunt.*

**HOUSES FOR GOVERNMENT OFFICERS.**—The Governor-General in Council is pleased to lay down the following rules in connection with the construction or purchase of residences for Government officials. When a house has to be built or purchased for the occupation of a Government official, its cost should be so regulated that the rental calculated under the terms of Resolution No. 479B of this date will not exceed 8 per cent. the salary of the official who will usually occupy it. In calculating the cost of a building to be erected a sum should be included to cover the share of tools and plant and establishment. The amount to be added for these charges may be specially approved of by the local Government, but should not be taken at less than 20 per cent. on the cost of "works."

**THE DRAINAGE AND WATER-SUPPLY OF VELLORE.**—With respect to the request of the council that a special officer may be appointed by Government, to finish the schemes for them, the Government, after consultation with



the Public Works Department, communicated that no officer could be spared. In furtherance of the said schemes the council have, at their meeting of the 18th June last, resolved upon inviting the aid of Mr. Oldham of Calcutta, and they are now in correspondence with him, through the Collector of North Arcot. Anything in this direction can only be effected after that officer visits Vellore and forms an opinion as to the practicability of the schemes. Levels for a complete system of drainage have been taken for nearly two-thirds of the town, and further work in this direction has been allowed to stand over pending the arrival of Mr. Oldham.

**SEEBPORE COLLEGE RE-ORGANIZATION SCHEME.**—The recommendations of the Committee briefly imply that the admission test for the Engineer Class should be higher than that which now obtains, *viz.*, the University Entrance Examination; that the theoretical training will be distinct from the practical; and that the latter should be undergone when the former is completed. Proficiency in both courses is necessary to entitle the student to a Certificate. The course of Practical Engineering will be gone through in either a large Locomotive or Government Workshop, or on important Public Works. The Committee are in a difficulty as to the true significance of the term "Technical Education," but have arrived at a very sensible view of the matter, and accordingly the scope of the College will be enlarged so as to embrace Agricultural and other *useful Arts and Sciences*.

**WISE PROCEDURE.**—The Chief Engineer, P. W. D. Madras, while fully appreciating the difficulty of obtaining detailed estimates for heavy repairs to a structure, such as the Madras iron pier, considers that, before the work is given out on contract, a specification and schedule of rates should be prepared in order that, when the repairs have been completed, means will be available to shew that the outlay has been reasonable. Should, however, it be considered more advisable to make a lump sum contract, it will still be necessary for a specification to be drawn up, in order that when the contract or reports that the repairs have been completed, there may be means available to check the work done. It will probably be found convenient to insist that the contractor shall keep a record of the work done on each bay and submit it to the Engineer as each bay is completed.

**CENTRAL INDIA ITEMS.**—The appointment of Executive Engineer, Gwalior Division, under the Central India Agency, the head-quarters of which have, since the rendition of Morar, been situated at Jhansi, is to be abolished, and Mr. Ewing, the present incumbent of the post, goes home immediately on sick leave. The greater part of the Gwalior, Etawah and Sipri Roads and 194 miles of the Agra-Bombay Trunk Road, *viz.*, from the Chambal Ferry to the Parbuti, has been made over to the Engineer in charge of the Gwalior State and the Public Works buildings at Sipri to the Executive Engineer, Jhansi Division, Military Works. The Executive Engineer, Provincial Works, Jhansi Division, will take over the 31 miles of the Gwalior Road from Jhansi to Sindh and 14 miles of the Sipri Road. Mr. W. Drake-Brockman, Superintending Engineer, Agra Division, who is now here on inspection duty, has been over these lengths in anticipation of the transfer, orders for which are daily expected.

**LORD DUFFERIN'S P. W. D. ADMINISTRATION.**—During no previous administration has the system of Railway communication been pushed on so fast and widely as

during the past four years. Since the day Lord Dufferin assumed the reins of office, without taking into account the 600 miles of military Railway which have been constructed on the Frontier, more than 2,000 miles of Railway have been opened, which will develop the commerce of the land, or tend to protect it from those periodical calamities of season which have so often in the past brought the widespread devastation of famine and death. Railways and canals are the works of public improvement, which have the chief effect upon the physical condition of the people. And no financial pressure, no exigencies of military defence have been allowed to interrupt the progress of irrigation works. During the past six years more than a million acres have been brought under their fertilising influence.

**ANOTHER STORM IN THE MADRAS HARBOUR.**—On the Engineer of the Madras Harbour Trust Board, inquiring whether the Trustees wished him to obtain estimates for dredgers and machinery necessary to carry out design No. 4A for a north-east entrance, or whether they wish particulars forwarded to Mr. Parkes, as it would be advisable to have designs and prices ready when required to save delay, it was proposed by Mr. Best and seconded by Captain Street that no action be taken until orders are received from the Secretary of State regarding design No. 4A; but against this it was proposed as an amendment by Mr. Eales and seconded by Mr. Cowasjee Eduljee that sanction be accorded to the Engineer obtaining privately such information as he desires, provided he does not in any way commit the Trust, and this was carried by a majority. A poll being demanded by Captain Baddeley votes were recorded as follows: For Mr. Eales amendment 6, against 5. Our sympathy is with the minority. The amendment sanctions irregular procedure and we should not be surprised at seeing it rescinded.

**RED HILLS TANK SYSTEM.**—We glean from the Notes of Inspection by the Acting Chief Engineer for Irrigation, Madras, that he inspected—(a) The Tamarapāk anicut, (b) Cholavaram tank supply channel, (c) Cholavaram tank, (d) Red Hills tank, which form the Red Hills Tank System, Chingleput District, and found them all evidently receiving careful attention and in excellent order. The extensive improvements to the Cholavaram tank supply channel have not yet been carried out. The intended formation of the "water cushion" below the new wall at the Red Hills tank, has been given up and a culvert of three 4-foot vents built in the road at the place; this was done on the recommendation of the Superintending Engineer with the approval of the Chief Engineer for Irrigation. The level of the water in the Red Hills tank was on 21st October last M.S.L.—39.56, or nearly 7 feet above the lowest pipe of the Madras water-supply and 2 feet higher than on the same date last year, though somewhat below the average height of the previous five years.

**ROORKEE ENTRANCE EXAMINATION.**—We have received the results of the Examination for Entrance to the Engineering Class at Thomason College, Roorkee, and the Lucknow Martinière College authorities are to be congratulated upon the extremely satisfactory position their candidates occupy in the List. The first nine places in the complete list of 40 from the various Schools and Colleges in the N. W. P. and Oudh, Bengal and the Punjab, are held by Martinière students. The candidates who have passed will enter the Roorkee College on the 1st May, when the actual number that can be admit-



ted will be decided by the Local Government. It will probably not exceed 16 in all. We notice that one less than a half of those that appeared obtained the qualifying number of marks—viz. 450, out of 750, or 60 per cent. The nature of this examination may be gauged by the fact that even Graduates of the Calcutta University in Arts have figured comparatively low in it. It is noteworthy that the Martinière sent up 10 competitors, and the one that failed only just missed passing by one mark in Science, which is an obligatory subject; but his total marks are far in excess of the total required for passing.

**FUTURE ROAD CESS OPERATIONS IN THE CENTRAL PROVINCES.**—Briefly, each district will be provided by the Administration with an Engineer officer and a suitable staff. These district charges will be Public Works Sub-divisions, grouped under a superior officer as Divisional or Executive Engineer. This arrangement will enable the Administration to take over the execution of all the public works of the District Council. All the works in the district requiring professional skill will be placed in the hands of the Sub-divisional Public Works officers, and for the execution of all works not immediately requiring professional skill and direction, the Deputy Commissioner of the district with his subordinate staff of all grades will be the responsible executive agency. The District Councils will retain all their present powers of initiation and control in respect to local projects. They will decide on the works to be undertaken, settle their order of urgency and request the commencement of work. The services of Local Boards and of individual members will be fully utilized by the Deputy Commissioner in carrying out petty works; but the responsibility for seeing that the works are done will lie with him. A programme of roads for every district in the Province has now been approved, and it is on the lines of the programmes that the Councils and Public Works Department will work.

**THE SILVER-LEAD MINES OF THE MYELAT.**—Mr. A. H. Hildebrand, Esq., C.I.E., Superintendent, Shan States, Burma, hearing that mining operations were getting more active in the Myelat silver and lead mines, deputed Mr. Barnard to visit and report on the system of working them, the royalty paid, apparent profits &c., and particularly as to what became of the lead. The shafts visited by him were in the territory of the Bawzaing Ngwegunhmu and are believed to be those which were visited by Mr. Jones in August 1887; but, on further inquiry, it was found that the mines visited by him were in the Kyauktat district of the Nyaunggywe States which lies to the south of Bawzaing and adjoins it. The ore therefore exists apparently over the whole of that tract. At present the workings are so small that nothing appears necessary to be done in the matter except to leave them alone and not interfere with them except in the matter of lead, the sale of which should be controlled so as to prevent its being sold broadcast as at present. It appears that the mining in this tract in King Mindon's time was carried to such an extent that some Rs. 500 weight of pure silver was produced daily, but that King Theebaw stopped all private enterprise and took over the working of the mines and, finding that under the peculations of his servants it could not be made to pay, the working ceased. It is only this year that a fresh start has been made in several parts of this tract.

## Current News.

CAPTAIN C. C. ELLIS, Royal Engineers, on arrival in India, is posted to the Lahore Division, Military Works.

MR. DENHAM, Chief Engineer, East Indian Railway, is expected back at Mokameh on 25th instant, and will resume charge from 1st January.

THE bridge over the Indus at Sukkur will be completed by the middle or end of next March, so far, at least, as to permit of a formal opening.

LIEUTENANT PALMER, Royal Engineers, with the Chin field force—was wounded near Kambale last Friday week and died on the following evening.

AN examination for admission to the Mechanical Apprentice Department of the Engineering College, Seebpore, will be held on 21st January 1889.

ON return from privilege leave Captain F. N. Maude, R.E., is transferred from the Quetta Division, Military Works, to the Meerut Division, Military Works.

A PETITION adopted by the London Committee of the Uncovenanted Civil Service Association comes out to India shortly for signature by members of the Service.

OWING to the decided improvement in prospects, we learn that the relief works recently started in Khurda, in the district of Puri, have now been brought to a close.

MAJOR F. T. N. SPRATT, R.E., is transferred from the Peshawar Division, Military Works, to the office of the Superintending Engineer, Meerut Command, Military Works.

THE Committee on Public Works Accounts, of which Mr. R. G. Macdonald is President, assembles at Allahabad yesterday and will probably remain there for three weeks.

ORDERS have been issued at Chatham for the selection of drafts from the companies of Royal Engineers at the School of Military Engineering for service at Singapore and Hong-Kong.

A MYSORE student, C. Sreenivasachar, B.A., passed first in the L. C. E. Examination, Bombay, and has secured one of the guaranteed appointments of the Western Presidency.

A RESOLUTION has been recently passed by a meeting of London brokers and merchants to absolutely boycott wool imports from the East Indies: because these are dishonestly adulterated with sand.

THE Russian Government is presenting the Economic Museum at Calcutta with a collection of the economic products of South Russia in return for the recent gift of a similar collection of Indian products.

It appears that the loss of the steamer *Vaitarna*, from the recent Marine Court enquiry, was due in a measure to the abolition of the Meteorological Department. Hence some share of blame would seem to rest on the Government of Bombay.

A RUSSIAN explorer is reported to have been for some time exploring the country to the north of the Mustagh Pass. It was by the Mustagh that Lieutenant Younghusband crossed into Kashmir at the conclusion of his journey across Mongolia from China.

THE recent accident to a troop train on the North-West Railway near Hamira has been investigated, and the cause of it has been ascertained to have been a collision. No rules or regulations can prevent accidents of this nature, which are brought about by the stupidity of individuals.

MR. MALLET, Consulting Engineer to Government, has completed his inspection of the Jhansi-Bhopal section of the Indian Midland Railway. He has not yet submitted his report, but it is understood that he will raise no objections to the opening of the line on the 1st of January.

A TYPICAL defamation case has just been disposed of at Howrah. A memorial signed by 111 natives alleged certain malpractices against the native Engineer to the District Board, and the charges contained in it were proved to be absolutely unfounded. The whole lot of the memorialists were convicted and fined in sums varying from Rs. 50 to Rs. 2.

A PROPOSAL having been made by the Victoria Jubilee Technical Institute of Bombay that it should be allowed to grant certificates of competency to Engineers under the Bombay Steam Boiler Inspection Act of 1887, the request has not been entertained for the present by the local Government, though it will consider it when the Act again comes under revision.



## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

### SEEBPORE ENGINEERING COLLEGE.

SIR,—A very just and reasonable complaint appeared the other day in the columns of a local contemporary of yours regarding the disqualification and inability to speak English of teachers recently appointed to teach the Overseer Classes of the above College, in which many European and Eurasian parents, in the humbler ranks of life, have a deep interest. That the Principal should have thought it advisable to employ failed fourth year students of the Engineer Class with ill-digested tons of theory and not an ounce of practice, and still less culture to express themselves well to mostly English-knowing boys, is simply ridiculous, and needs only to be brought to the notice of the proper authorities to be seen to at once. I fear, Sir, the Principal is inordinately fond of doing things on the cheap, to conciliate the powers that be, and though he must know as well as everybody else that, vulgarly speaking, hens don't lay big eggs at 9d. a dozen, yet he must needs save Government monthly more than three-fourths of the late Mr. Gilmore's pay at the sacrifice of the best interests of the boys, and refuse to hold out a little better inducement to make it worth the while of a really good man to take up the responsible work of teaching.

December 12, 1888.

PICKAXE.

### RETIREMENTS IN THE P. W. D.

SIR,—There is a rule, page 60, Civil Pension Code, that "no Chief Engineer of the Corps of Royal Engineers shall, without re-appointment, hold the same post for more than five years. This rule, in the case of officers, who on appointment to that rank, received notice of the probable issue of this order, will take effect from the date they joined their present posts. In other cases, the rule will take effect from the date of these orders."—September 3, 1880.

The intention of this rule is persistently evaded by changing the appointments.

The Doctors' case, which you published, is what the C. E's. are asking for. The Doctors get as a concession three years' pension service given them on the ground of professional training. We should get, at any rate, two years and Staff Corps pensions. We are going for this.

The following order only applies to men 55 years of age:—

"Of the other officers, those who were appointed to a new office, class, or grade, before 18th August 1882, may continue, notwithstanding these rules, to hold that office, class, or grade, until five years from the date of such appointment, but may not be promoted or receive a new appointment if they have attained the age of 55 years."

CIVIS.

### P. W. D. RE-ORGANIZATION.

SIR,—The Civil Engineers' Association have printed a minute on Government of India's No. 1432 G., dated 15th June 1888, and ask for further criticism on it.

It appears to me that no re-organization can be effective without some reduction to begin with, especially of the men over 20 years' service, 1st grade executives, and other senior men for whom suitable employment cannot be found.

The only practicable way of reducing would be to enforce the 50 years' rule for Military and Civil officers, giving them compensation for disturbance, and keeping this rule in force until the necessary reduction is effected. If it were possible to obtain pensions in sterling or even fix the rate at some equitable figure, it would not be necessary to keep this rule in force very long.

Having fixed the strength of the Department and regulated the yearly admissions to suit, any increase of strength at any time required should be met by engaging men temporarily.

This is the whole secret of success—the employment of temporary men for temporary and purely provincial works.

Having expressed my ideas as to the shape re-organization should take, I will say a few words on the suggestions in the minute above mentioned.

The idea to divide the present Department into three classes—above average, below average, and incompetent is impracticable. There may be a few men, who, everyone would agree, belong to the latter class, and Government would, I think, be justified in retiring them with some compensation for so doing.

But to divide the above and below average men is invidious, and

the proposition to give the below average men to the Provincial service would naturally be resented by the Provincial Governments and the men themselves. Each province should have their proportion of men from the Imperial service, and any more required should be obtained in the open market.

For the success of this scheme the Provincial Government should not be allowed to form the District Engineers and other temporary men into a service at all. Agreements should be made with each man separately not necessarily for the same period or pay, and it should be distinctly understood that the rate of pay should not be altered as long as the agreement was in force, when a further agreement might be determined by mutual arrangement. The pay would entirely depend upon the ability of the officer, the responsibility of the post for which he was engaged, as well as the state of the labor market at the time of engagement, and should have no parallelism with the grades or pay of the Imperial service.

G. E. M.

December 11, 1888.

### REVERSE CURVES.

SIR,—I am much obliged to Mr. Ewbank for the trouble he has taken in investigating the general case of the problem I drew his attention to. As he asks me to "establish" my formulæ, I enclose the solutions, but they are scarcely worth publishing. I am sorry I was not more careful in stating the problem in the first case.



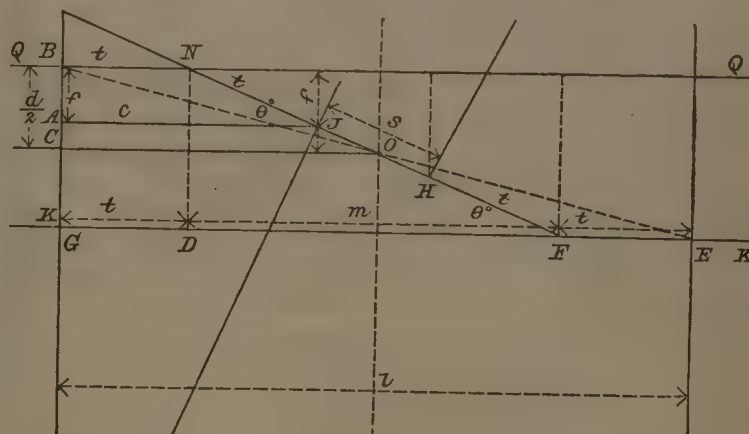
R and S are fixed, and invariable, for all cases and  $d$  is the perpendicular distance from main line to diversion at the point you wish to get round, also given.

$\theta$  is the inclination of the diversion line to the main line.

The tangents  $t$  and  $t'$  will of course not be equal, except when the lines are parallel, nor will the curves be equal in length.

Required to find  $l$ ,  $t'$  and  $t$ .

The solution is probably too complicated for practical use.



Let  $BC = \frac{d}{2}$ , and  $CO$  parallel to  $QQ$ , cutting  $S$  in its centre.

$BA = f$ , i.e.,  $A$  is the foot of the perpendicular from  $J$  on to  $BG$ .

Also let  $JA = c$

$f = t \sin \theta$

and also  $= \frac{d - S \sin \theta}{2}$



$$\therefore t = \frac{a - S \sin \theta}{2 \sin \theta} \dots\dots\dots (1)$$

Again,—

$$c = t (1 + \cos \theta)$$

$$\text{and also} = \frac{l - S \cos \theta}{2}$$

$$\therefore t = \frac{l - S \cos \theta}{2(1 + \cos \theta)} \dots\dots\dots (2)$$

Equate the two values of  $t$ , and it will be found that

$$\frac{\sin \theta}{1 + \cos \theta} = \frac{d}{S + l}$$

$$\text{i.e., } \tan \frac{\theta}{2} = \frac{d}{S + l}, \text{ and since } R = \frac{t}{\tan \frac{\theta}{2}}$$

$$\therefore t = \frac{R d}{S + l}$$

Again,—

$$D F - m = (l - 2 t), m^2 = N F^2 - d^2,$$

$$\text{and } N F = (2 t + S);$$

$$\therefore (l - 2 t)^2 = (2 t + S)^2 - d^2;$$

$$\therefore l^2 = 4 t \times (S + l) + S^2 - d^2 = 4 R d + S^2 - d^2.$$

R. L. CAMPBELL.

### THE LAHORE CATHEDRAL.

SIR.—In discussing the merits and demerits of the P. W. Secretariat buildings at Lahore, it occurs to me that a few words on the above magnificent Cathedral would not be out of place here.

Unfortunately I am not in a position to furnish you with a "Plan and Elevation" of the Lahore Cathedral, but you will readily believe me when I assure you that it is a really magnificent building, and the greater is the pity that the "Western Towers," which naturally form the *chef d'œuvre* of a Cathedral must be left off abruptly at the square for want of funds to complete them. However, if the present Bishop be only half so successful as his learned predecessor, the Western Towers shall be completed during the present incumbency.

It is strange what magnificent builders distinguished prelates have been; from "William of Wykeham" to our own late but still beloved Bishop French of Lahore.

The Lahore Cathedral, magnificent as it really is, has one grave fault, namely, too short a nave; had it only 15 to 25 feet more in length of nave it would be unsurpassed in India. This defect, grave as it is, is nevertheless shared by a far more splendid, more glorious Christian Temple than that of Lahore, namely, the Cathedral of Cologne, commenced it is believed early in the 13th century and only completed in 1882; a Cathedral which Ferguson has described as the most "Magnificent Temple ever erected by man in honor of his Creator;" and adds, that it is a splendid triumph of the mason, but a failure as a design. What a pity that this should have been permitted to occur in such a splendid edifice as the great Cathedral of Cologne.

The Lahore Cathedral is constructed throughout in the very best brickwork, almost blue colored, so thoroughly have they been fired; the dressings are Tarakee Ashlar, with slate roof.

E. R.

[We gave some illustrations of this building in our issue of March 5, 1887.—Ed., I. E.]

### DEPARTMENTAL RE-ORGANIZATION.

#### I.

SIR.—In my letter of the 30th October, published in your issue of the 17th November last, my object was to point out a few of the objections to the scheme propounded by Government for splitting up the present superior service into two services, unequal in position and pay, though officered by Engineers bearing the same titles.

2. I see that "Veritas" is of the same mind as myself in regard to the impracticability of the scheme in its present form, and has made some thoughtful and sapient suggestions, such as might be expected from one who has evidently made the Department a study.

3. There is no doubt that Departmental Organization is a science, and as such demands of those who would master it, deep

study, much thought, a considerable knowledge of human nature and actuarial statistics, as well as a mind trained to systematic and logical reasoning. Until this science is recognized as a science, and its laws evolved and arranged, we can scarcely expect to see the Department satisfactorily organized on a sound permanent basis.

4. "Veritas" seems to think that the time has at length come when Government is realising the necessity of re-organising radically and in real earnest, instead of in the haphazard and unsystematic way which has characterised most of the previous movements in that direction; if this be so, it is much to be hoped, that Government will see the desirability of adopting "Veritas'" suggestion to call a representative committee of Engineers of all classes in the Department, to formulate proposals. The committee should be composed of men who command the confidence and respect of their brother Engineers of the classes they respectively belong to, and it should be instructed to go fully and deliberately to the root of the whole question, with a view to investigating, enunciating, and reducing to scientific order, the laws and principles which must be followed out, in order to produce a scheme free from patchwork anomalies and glaring impracticabilities.

5. Destructive criticism is easy but of little avail; and though I do not pretend to possess any profound acquaintance with the, as yet unwritten, laws of Departmental Organization, I venture, at a time when any ideas may be useful, to offer for discussion and criticism the following suggestions of a constructive nature, as a set-off against the criticisms in my previous letter, and alongside of, not in opposition to, the excellent suggestions already put forward by "Veritas."

6. The requirements of a Public Works Department seem to be elasticity, efficiency in control, efficiency in execution, thorough contentedness, a practicable system of rewarding and encouraging merit, and of discouraging and checking inefficiency, (safeguarded from abuse in both directions), and all this with the least possible cost to the State.

7. I think a mistake has been made in the recent Government scheme, in mixing up (a) the future permanent condition of the Department with (b) the transition processes necessary to evolve the final régime out of the existing muddle. The transitional changes are the most important to us, of course, who are only directly concerned with the affairs of the next 20 or 30 years at most, but the permanent outcome is far and away the most important to Government, whose interests extend into the distant future. It is expected that any scheme would only take from 17 to 20 years to work out to its final perfection. It would seem, therefore, reasonable first to decide upon the form the Department is finally to take, and then, and not till then, to turn to the consideration of the best way of working out the intermediate operations of reform. I do not propose to touch the latter part of the problem in this letter; but I wish to emphasize the desirability of not letting the passing difficulties of transformation interfere with, or spoil, the perfectness of the finally developed system.

8. To my mind, the efficiency of any permanent scheme suited to this country must depend largely upon the recognition in it of the following principles:—

(a) That there are two distinct functions of a Departmental Engineer; *control and execution*.

(b) That control and administration carry with them higher responsibilities, and require a more highly trained, and therefore more highly paid, body of men, than the actual execution of the work does.

(c) That it is therefore desirable to recruit the Controlling and Administrative officers from the best available source; but that as they must be more highly trained and paid, it is a waste of money to keep a larger staff of them than is absolutely necessary, or to employ any officer engaged ostensibly for control longer doing executive duties than is absolutely necessary to enable him to acquire a thorough fundamental knowledge of the details of the executive work, in the control of which he is to spend the better part of his service.

(d) That, on the other hand, the actual execution of the work which, if efficiently controlled, does not require the services of such highly trained men to carry out, should be confined to a more cheaply paid service; and that officers in this service, having been engaged ostensibly for executive work, should not be expected, or themselves expect, ever to be placed in the higher positions of control and administration, for which they have not, *a priori*, received the necessary higher training.

(e) That the two services being organized and maintained for two distinct purposes and on entirely separate footings, their nomenclature and mode of grading should be as different as possible in order to intensify the absence of any connection between them.

(f) That while maintaining a rigid distinction between the controlling service and the executive service, there should be no distinctions of any kind between classes of men doing the same work in the same service, whether that service be the controlling or the executive service.

(g) That different scales of pension should be fixed for the two services with reference to the salaries of each; but that whatever scales are fixed, it should be a *sine quâ non* that men retiring to live in India should draw their pensions in rupees, and that men retiring to live out of India should draw their pensions in pounds sterling at the rate of ten rupees to the pound.



(h) That the period spent in each grade or rank throughout either service should be such, that the majority of the best years of each man's life should be utilized on the particular work for which he was trained and engaged.

(i) That the proportion of officers in each rank in either service from the highest to the lowest should be such as to guarantee to every efficient officer a fair hope of rising, during his 33 years of service to the higher (if not the highest) posts in his own service.

(j) That the combined annual cost of the two services (including pensions as already arranged for in section g, above) should not be greater, in proportion to the work executed and controlled by them, than that of the existing service is to the work carried out by it.

9. To consider these principles seriatim:—

(a) The functions of control and execution are undoubtedly to a great extent distinct. A man, as for instance a good upper subordinate, may be an excellent executive officer, and yet not at all fitted, either socially or intellectually, to hold a high controlling or administrative post. On the other hand (though this is a less common case) officers who make excellent controllers and administrators have not always proved practical executive workers.

(b) About this there can, I suppose, be no question.

(c) The qualities required for control and administration are eminently such as are met with in men brought up and educated in England. It is for positions where judgment, tact, the calm steady discharge of responsibilities, and the power of governing, are required that the English trained Englishman is so valuable.

(d) But in many respects the Indian, whether of English, native, or mixed parentage, is more fitted for executive work than his English trained comrade. He may be expected to possess a better knowledge of the country and its resources, to be in closer touch with the people he has to work with, and to be better acclimatised. In the matter of pay he is well remunerated with a considerably smaller income. In the first place a native of any country can make his pay go much further than a foreigner can, both as regards his own wants and the educational requirements of his children; and in the second place, having regard to the proposals for the far future which we are now considering, the classes from which the average of the new Provincial Service would be recruited in India, would probably be lower than those from which the average Engineer recruited in England would be drawn, for the simple reason that the well-to-do classes in India send their children to England to be educated and to choose a career. Nor can there be a doubt but that if the less highly trained and paid service were once fairly started, (independently of the indefensible proposal to force into it compulsorily men already engaged on more favorable conditions of service,) plenty of men born and bred in India, Europeans and natives, would be perfectly contented to enter it, and would not feel envious of the position and pay enjoyed by the superior service, provided that no gratuitous inducements, (such as the retention of the same nomenclature in both services,) were offered for a comparison between them.

(e) The retention of the titles "Executive" and "Assistant" Engineer for both services will be, I am sure, one of the chief obstacles to the successful working of the scheme as set forth by Government; an obstacle which would be at once removed by the simple expedient of adopting a different nomenclature in each service. This might be done by according to the Provincial Service the well established and honorable titles of "Executive" and "Assistant" Engineers, and selecting some new designation such as "Controlling" Engineer for the junior ranks of the Imperial Service. This would necessitate a slight modification in the Royal Warrant of Precedence.

(f) and (g). Everybody, even Government, admits the soundness of the principles enunciated; they will have, probably, to be conceded sooner or later in practice, though at present the Government does not seem disposed to do so (*vide* paragraph 39 of their scheme). They could scarcely be withheld in any scheme which effected a considerable saving in other ways to the State.

(h) Is a logical deduction from c and d, it being obviously absurd and un-economical to keep a man, specially trained for controlling purposes, engaged, during a large portion of his service, doing executive work which could be done more cheaply by a man specially trained for it, and drawing a lower salary; while it would be false economy to keep a large staff of more highly paid men for control, and yet to hand over controlling appointments of any importance to members of the less highly trained service, or even the less important posts of control for more than a few concluding years of their service, in selected cases. At the same time it must be remarked that this principle is at present largely broken through; men being kept, owing to the fearful stagnation in promotion, far too long doing not only Assistant Engineers' work, (as is rather naively admitted in paragraph 20 of the Government scheme,) but Executive Engineers' work also. Indeed, unless the new scheme is carefully planned, and healthily worked, the present objectionable state of things is, in this respect, likely to find a sequel in the Imperial Service.

(i) Is almost a continuation of the principle h last enunciated. The idea is touched upon as regards the lower ranks in paragraph 5, and conclusion 2 of paragraph 16, of the Government scheme. But there seems to be no recognition of the fact that men have a legitimate expectation of rising beyond the rank of Executive

Engineer to become Superintending and Chief Engineers. Paragraphs 10, 11, and 18, of the Government scheme seem to shew that under the new proposals few men can hope to rise in the Imperial Service above the rank of Executive Engineer. Of course, as I have stated in paragraphs c and d, I propose to recruit the 80 superior posts entirely from the Imperial Service, which will considerably improve its otherwise ghastly prospects.

(j) Lastly, it is essential to the acceptance of any scheme by Government, (as "Veritas" has pointed out,) that it should not entail increased proportionate expenditure.

10. With your permission I hope to suggest in your next issue the main features of a scheme such as I believe would be found to fulfil the above conditions more satisfactorily than they are fulfilled at present, or than they would be under the terms of Government scheme as published; and I believe that this would be done at an annual saving to the State, on salaries alone, of nearly 5 lakhs of rupees per annum.

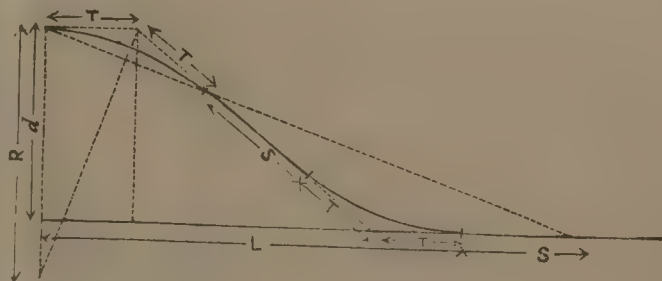
POUNDS.

## DIVERSIONS FROM A STRAIGHT ROAD BY REVERSE CURVES WITH "STRAIGHTS" BETWEEN.

SIR,—The very simple solution of this problem stated by Mr. Campbell in *INDIAN ENGINEERING*, 10th November 1888, is not given in any book that I know of.

As the proof, although a simple one, is not at once evident from the figure below his note, and is not given in detail by Mr. Campbell, I venture to give it here, with an explanatory figure.

Fig 1.



By similar triangles,

$$\frac{T}{R} = \frac{d}{L+S} = \tan \frac{\alpha}{2} \dots\dots\dots 1)$$

It is also clear, from the diagram, that—

$$L = 2T + \sqrt{(2T+S)^2 - d^2};$$

$$\therefore (L-2T)^2 = (2T+S)^2 - d^2;$$

$$\therefore L^2 = 4T(L+S) + S^2 - d^2$$

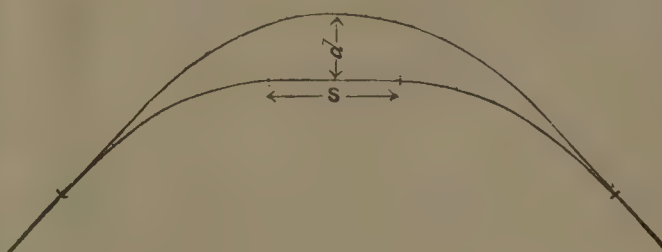
$$= \frac{4Rd}{L+S} (L+S) + S^2 - d^2;$$

$$\therefore L = \sqrt{S^2 + 4Rd - d^2} \dots\dots\dots (2)$$

Unless a long piece of straight is required in the middle of the diversion the curve should, if possible, be made continuous over that portion, to avoid the necessity of working off and again resuming the super-elevation of the outer rail.

When the diversion is required from some point to another on lines inclined to each other, it will often be possible to avoid the use of reverse curves altogether, as indicated in the second figure, by laying the diversion on a chord line.

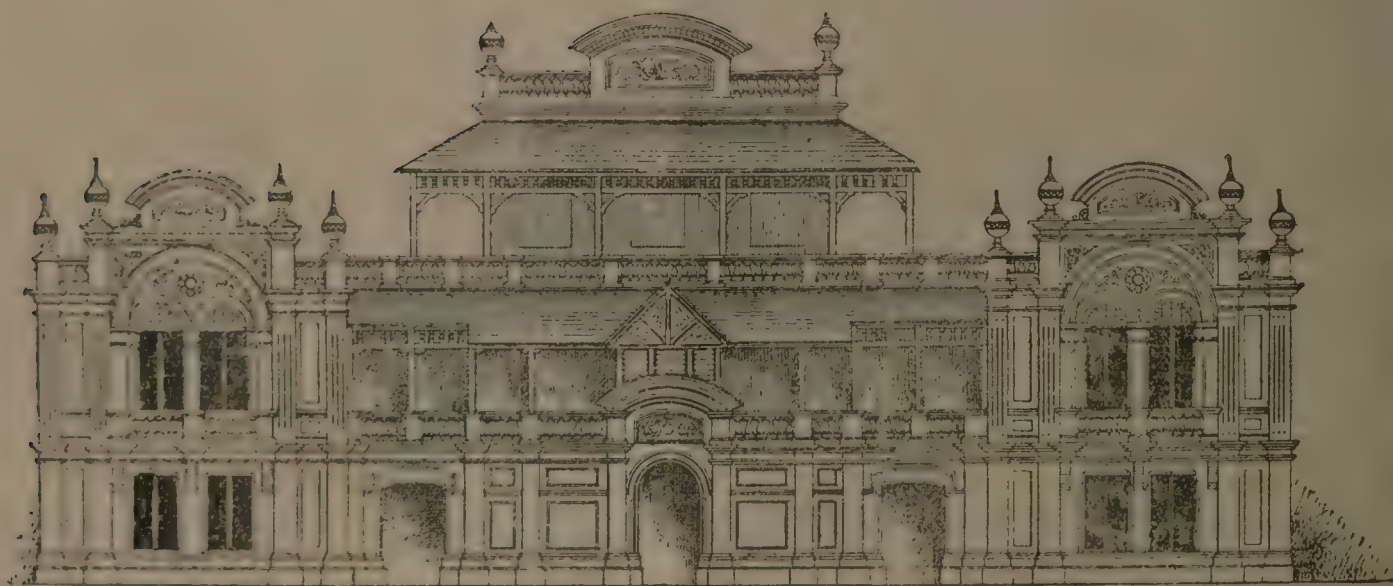
Fig 2.



W. H. COLE.



## General Articles.



THE MUNICIPAL OFFICES, MADRAS.

SOME time ago it was proposed to vacate the old Municipal Offices in Erra Balu Chetty Street, Madras, and erect a new building near the central station, for which designs were supplied by Mr. W. N. Pogson, F.S.A., Architect, at a cost of about  $1\frac{1}{2}$  lakhs. Owing to the difficulty of obtaining a suitable site, and the present financial crisis, this scheme was abandoned. Mr. Pogson was then instructed to submit a plan for extending the present old building. The work has been most successfully carried out from Mr. Pogson's working drawings by the department, and the result is far more agreeable than can be gathered from the geometrical elevations we illustrate. The whole of the frontage is in Portland

cement plaster relieved by buff terra-cotta panels and enrichments admirably executed by the Madras School of Arts. The old godown-building in the front of the offices has been demolished, and the ground laid out into an ornamental garden, with an eastern and western carriage gateway and boundary wall. The floors of the building are constructed with iron girders and brick arches overlaid with Minton tiles. The walls are decorated with stencilled dado and frieze bordering to all the inside rooms. The estimated cost was Rs. 22,000.

The upper figure of the two given above is the original frontage, and that given below it is the new one as designed by Mr. Pogson.



## WATER-SUPPLY, SURFACE DRAINAGE AND SEWERAGE OF THE TOWN OF SUKKUR IN SIND.

BY COLONEL W. M. DUCAT, R.E.,  
*Consulting Sanitary Engineer to the Government of Bombay.*

### GENERAL DESCRIPTION OF SUKKUR.

*Geographical Position.*—Sukkur, the Chief Commercial Town of the Shikarpur and Sukkur Collectorate in Sind, is situated on the right bank of the Indus, and west of that river, in Latitude  $27^{\circ}41' N.$ , and Longitude  $68^{\circ}54' E.$ , at an elevation of about 200ft. above Mean Sea Level.

On the opposite bank of the Indus stands the Town of Rohri, and in midstream, between Sukkur and Rohri, is the island and old fortress of Bukkur; separated from the banks on either side by a very deep channel and a current of great velocity. The geographical position of Sukkur, its excellent water communication extending as far inland as Multan, and down to Kotri, its importance as the Headquarters of the Indus Valley State Railway, and the strategical base of the Frontier Railway system towards Quetta, make it a place of great and rising importance, and its trade is considerable.

*Geological Formation.*—A range of low hills, or a series of ridges more or less detached from each other, form the central feature round which the town of Sukkur clusters. These hills, the highest point of which is about 70ft. above the plain, are composed of a hard granular rich limestone, evenly and rather minutely stratified, the layers of stone being in themselves very much broken and fissured. The strata have a dip to the north, where the hills gradually rise from the plain, and terminate in abrupt cliffs on the south. These hills are totally devoid of vegetation and reflect a glare from their white arid surface which must be very trying in the long summer and intense heat of Upper Sind. The plain surrounding these hills, is composed of limestone detritus and river deposit, forming a light calcareous clay or loam, in which there is a good deal of salt. This loam is stiff enough to make good bricks, but is not by any means water-tight, and the salt in the soil is not sufficient to make it barren or prevent its yielding rich crops where well cultivated and watered.

*Town of Sukkur.*—For all purposes of this Report Sukkur may be considered as two quite distinct towns, viz., Old Sukkur, at the foot of the hills to the north, with its population of about 6,000 inhabitants; and at a distance of nearly a mile the conjoined towns of New Sukkur, with its population of about 18,000 inhabitants, and Gharibabad, with its population of about 11,000 inhabitants, situated under the cliffs on the east and south of the hill; with what is termed the European Quarter, on the high ground between them. The most noticeable feature about Sukkur is that both the old and new towns are situated on ground lower than the flood level of the Indus, from which they are protected by embankments: Old Sukkur is sheltered under the Sukkur Canal and its protecting embankment; and New Sukkur and Gharibabad are rendered safe from inundation by the Indus by the fine wharf wall which forms the entire river frontage of New Sukkur. The great importance of the river borne trade has caused the principal wealth and enterprise of the place to gravitate to the low ground immediately in rear of the wharf at New Sukkur, where land is now very high priced; and though house property in this position is secured against the encroachment of the river, it is endangered by the want of surface drainage, which affects, more or less seriously, most parts of the native towns of Sukkur. Most of the houses in Sukkur are designed with very low plinths, and are built of sun-dried bricks, in which there is salt; so that a rise of surface water around a house entails, not only considerable damage to property on the ground floors of the house, but involves very great risk of the total collapse of the whole house itself, the footings of which are apt to melt away if saturated: and as the low-lying parts of Sukkur are

about five feet below flood level of the Indus, and the rainy season occurs at the time that the river is high, this question of surface drainage is a very important one, endangering life and property to a great extent, and the subject has naturally met with much earnest consideration from the Municipal authorities, resulting in the construction of works, which will be referred to in the next chapter of this report.

*Rainfall.*—There are no reliable records, from which the rainfall at Sukkur can be ascertained; but from private notes and other sources, it is gathered, that a rainfall of 13 inches in the year has been registered; and that, in any surface drainage scheme, provision should be made for the disposal of as much as three inches in one heavy storm of four hours' duration; rain as heavy as this having been known.

### NEW BRIDGES IN MYSORE.

BY LIEUT.-COLONEL C. BOWEN, R.E.,  
*Chief Engineer, P. W. D., Mysore.*  
TUNGA BRIDGE.

A MASONRY bridge of 9 arches of 50 feet span, with springing line about 25 feet above deepest part of river bed has been designed.

The site, about 1 mile above the ford and ferry crossing at Hariharpur, was selected some years ago by Messrs. McLaughlin and Srinivasa Rao. I inspected and passed it on my last tour in the Koppa District. It is on all scores the best available, although it involves a rather long deviation from the present main road which cannot be avoided. The rocky bed and well defined waterway at the place selected afford the best advantages for design and construction.

The Executive Engineer Mr. Sitarama Rao, has given carefully worked out calculations for the waterway, according to the different methods usually adopted in such cases. It will be observed therefrom that "Ryves' formula" gives for the river at Hariharpur a discharge of 28,672 cubic feet a second; Dickens' formulæ 53,996 cubic feet; whilst calculations based on the cross and longitudinal sections of the river give a flood discharge of 105,522 cubic feet per second.

But the former two empirical formulæ are acknowledged to be unreliable, and for areas such as those drained by the upper reaches of the Tunga and Bhadra they may be considered as wholly inapplicable. The safest method of ascertaining the discharge is that adopted from the measured sections of the river and the velocity calculated according to Kutter's or Bazin's formulæ. The discharge so arrived at, 105,500 cubic feet per second, corresponds with what we may fairly consider to be the approximate run-off, 9-14ths of an inch, from the surface of 265 square miles adjoining the Western ghats, and may be safely assumed as sufficiently accurate for basing our bridge design upon.

The bridge proposed will have a sectional area of 10,100 square feet up to springing of arches. The "afflux" caused by the obstructed waterway will be about  $\frac{3}{4}$  of a foot, and the discharge arrived at as above will be forced through the bridge at a velocity at 9.72 feet per second. The rocky bed will withstand this velocity.

The highest flood known in those parts, that of 1882, rose some 3 feet higher than the springing level we have adopted. Adding to this  $\frac{3}{4}$  foot for afflux there will still be 8 feet clear between the highest possible flood and crown of arches.

Some Engineers, I am aware, hold that the springing of arches should never be lower than the highest known flood. I do not agree with this dictum when we have solid foundations, a waterway nearly corresponding with the natural waterway, a high versed sine of arch, and a substantial structure of great lateral stability. We have examples every day which prove that extraordinary floods are passed with safety though filling nearly the whole archways, so long as the foundations are perfect and the structure substantial. I need hardly say that to insist on a springing line above the very highest recorded flood,



such floods being entirely exceptional, would in a big bridge involve very considerable extra cost. In this case I consider there is absolutely no risk.

I have adopted 50 feet spans, in communication with Mr. Sitarama Rao, after due consideration. I would have preferred 60 feet spans, but the difficulties connected with labor and the necessity for rapid work outweighed other considerations, and easy foundations tell in favor of shorter spans. The greater span and greater rise would have the distinct advantage of passing more readily large floating trees, but as regards this element of danger, I have no apprehensions that the span and rise adopted will not prove sufficient. The arches of the bridge at Shimoga, 50 feet spans, have hitherto passed with safety such floating timber.

Mr. Sitarama Rao has designed long splayed wings. It will be seen from the cross section that these will be sunk almost entirely in the solid banks. In such a position I do not think splayed wings quite suitable. I will alter these to wings or returns in the direction of the bridge, slightly curved outwards, which will be more suitable and will be decidedly cheaper. Splayed wings are but too frequently built into steep banks to which they are not adapted.

The Executive Engineer has designed over the abutment piers recesses for the roadway, in which foot passengers can rest. I would not carry up the massive cutwaters as he proposes. I would limit the projection of these cutwaters to the length of radius of curve only, and I would form the recesses on roadway, which are desirable, by simply corbelling out the road and parapet. This will, I believe, look very much better, and money will be saved thereby.

The Estimate amounts to Rs. 121,799.

#### BHADRA BRIDGE.

Eleven spans of 50 feet each have been designed, arches elliptical or three-centred

The site is at Balehonnur.

The discharge of the river has been arrived at by the methods adopted for the Tunga. It is 110,900 cubic feet per second, the drainage area being 305 square miles. The bridge will pass this discharge with an afflux of  $\frac{1}{4}$ th foot and velocity 7.5 feet per second.

It will be observed that three of the eleven spans are so-called "land arches," being entirely outside the ordinary trough of the river. The river floods heavily over the flats on this bank, and it would be dangerous to confine the waterway to the defined bed as a very high afflux and tremendous scour would probably result in heavy floods. The site was selected many years ago. It is very favorable, there being a bed of sheet rock all across the river, and it has had the approval of all the officers who have inspected it. There is in fact no other site equally suitable in the neighbourhood. Three-centred arches have been adopted, as affording more headway above floods. I would be satisfied myself with segmental arches, as in the Tunga bridge, but as the elliptical arches will present a better appearance, I have allowed them to stand, although more difficult to build.

The remarks made against the Tunga bridge, about wings and recesses, hold good for this bridge too. I have further to add that the burnt stone slabs, shewn as strings round piers and abutments at springing level, are not quite the thing. We require instead cut-stone "skew backs," the faces of which may project 3 inches or so to mark the cornice level. These changes will but slightly affect the estimates.

Considering the difficulties of the locality, distance of materials, &c., the rates are on the whole fair. First-class massive work will be required, and the working season being very short, rapid progress during the working months, and therefore judicious arrangements for labor, will be essential. Mr. Inman will be in charge of the works and I hope to find suitable contractors with capital sufficient and energy and experience of ghat works to ensure success.

The Estimate amounts to Rs. 1,35,033.

AKRA BRICK EXPERIMENTS, (Continued from Page 472.)  
By H. LEONARD, M.I.C.E., Late Chief Engineer, P. W. D., Bengal.  
SECOND SERIES.

To test the strength of Splayed Foundations.

No.	Foundation of Pier.	Plinth of Pier.	Foundation of Pier below ground level.	Age of Pier.	Quality of bricks and proportions of ingredients.	Total load.	Position of cracks.		Remarks.
							Tons. cwt. qrs. lbs.	Vide Sketch No. 4.	
4	6' x 2'	2' 2 $\frac{1}{2}$ " x 2' x 2' 1 $\frac{1}{2}$ "	4'	15 days.	1st class Akra bricks and mortar composed of two of soorkee to one of lime.	11 9 2 10		No. 4.	The weight was put on the plinth, the off-sets being at an angle of 45°, commencing from the height of 1' 9 $\frac{1}{2}$ " of masonry.
5	6' x 2'	2' 2 $\frac{1}{2}$ " x 2' x 2' 1 $\frac{1}{2}$ "	4'	3 months old.	1st class Akra bricks composed of two of soorkee to one of lime.	23 18 0 0-16		Vide Sketch No. 4.	No crack in the masonry was visible after being weighted 30 hours when the load and pier tipped over on the south side. The soil below was soft from moisture, the heavy rain that fell on the 24th and 25th of last month having saturated the ground.  The Masonry is the same as No. 4, only older.  With $\frac{1}{2}$ ton to the foot, one hour on no disturbance. " ditto, ditto. " ditto, ditto. " 1 ditto, ditto. " 1 $\frac{1}{2}$ ditto, foundation sunk slightly, but no disturbance in the masonry. " 1 $\frac{1}{2}$ tons to the foot, one hour on, foundation sunk more, but no disturbance in the masonry. " 2 tons to the foot, 13 hours on, foundation sunk one brick, but no disturbance in the masonry.

This experiment shews that a foundation of this shape is rather too strong.



N EN

ICK E

Nº 4.

Elevation

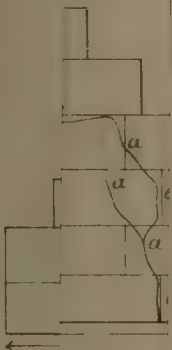
2' 2 3/4"

Ground

Line

2' 1 1/2"  
\*  
1' 6 3/4"  
\*  
1' 9 1/2"

6' 0"



arked a s  
ich appea  
a load of  
f! Lines  
Cracks wh  
r wall with  
to the supls

18.

Nº 5.

Elevation

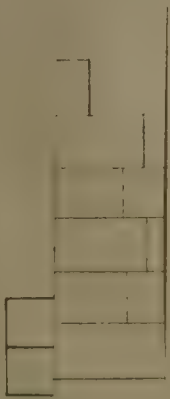
2' 2 3/4"

Ground

Line

1' 1 1/2"  
\*  
1' 6 3/4"  
\*  
1' 9 1/2"

6' 0"









AKRA BRICK EXPERIMENTS.  
SECOND SERIES.

*To test the strength of Splayed Foundations.*

No.	Foundation of Pier.	Plinth of Pier.	Foundation of Pier below ground level.	Age of Pier.	Quality of bricks and proportions of ingredients.	Total load.  Tons. cwtz. qrs. lbs.	Position of cracks.
1	6' x 2'	2' 2½" x 2' x 2'	1'	19 days.	1st class Akra bricks and mortar composed of two of soorkee to one of lime.	12    1    0    14	Wide Sketch No. 1.  The pier was constructed on the natural soil and loaded at the rate of 1 ton and 38½lbs. per square foot. On lowering the screw jacks, 2 bricks and 17 mortar joints on the north and 2 bricks and 9 mortar joints on the south cracked, and as the load preponderated more on the north side, the wall on that side sunk about ¼ inch in the centre and was 2 inches out of plumb. Second day it was seen that the former cracks on both sides became wider by 1 brick and 2 mortar joints on the north and 1 brick and 14 mortar joints on the south side. Third day, Sunday. No observations taken. Fourth day. No further cracks appeared, but the former ones became rather wider. An additional load of ¾ ton per foot was put on upon when the pier sank about 3 inches on the south side. If concrete were added, of course it would be stronger, but this was to test the strength of the masonry, not of masonry and concrete. Experiment on played foundation wall having a footing of 6 inches in depth and off-sets being at an angle of 45°. With ¼ ton lead to the foot, which remained on one hour, no perceptible disturbance. " ⅓ ton to the foot no perceptible ditto. " ½ ton to the foot ditto. " 1 ton to the foot, which remained on all night, 13 hours, nothing perceptible. " 1½ tons to the foot, one hour, on the wall slightly sunk in the ground, no disturbance in the brickwork. 1½ tons to the foot, one hour on, slight cracks appeared in the wall marked A. on the elevation. " 1½ tons to the foot the former cracks became wider and additional cracks in the wall took place, which are marked B. on the elevations. The cracks in the two lowest courses were about ¾ inch in width. The wall sunk about ¾ brick in the ground, settlement being fairly even. Executive Engineer adds that the experiment No. 1 was on a wall similarly constructed to the one herein reported, but was only 19 days old. On comparing the two experiments the difference in the strength of foundations is very marked, and this no doubt is owing to the difference in the age of the masonry, 19 days and 3 months. The masonry of this trial was very carefully built, good hand and good mortar, most probably better work than could be expected in all parts of the foundations of a large building and was kept free from all extraneous moisture; it cracked with a load of 1½ tons to the foot. This is not much in excess of the weight on foundations of some of the large buildings in Calcutta it is believed ; it would therefore appear to be too weak in design to leave a safe margin for indifferent or careless work and other contingencies. With ¼ ton to the foot, one hour on, no disturbance perceptible. " ⅓ ton to the foot, ditto, ditto. " ½ ton to the foot, ditto, ditto. " 1 ton to the foot, ditto, ditto. " 1½ tons to the foot, ditto, ditto. " balance of the brickwork, ditto, a very slight settlement in the ground, but no disturbance of the brickwork. " 1½ tons to the foot, ditto the foundation sunk in the ground a little more, about ¼ an inch, and the masonry cracked slightly, as shewn at the places marked A. on the sketch. " ditto, the load remained on all night, 13 hours, the former cracks, marked A. became a little wider, and the additional cracks marked B. were shewn. " 2½ tons to the foot, the former cracks marked A. and B. became a little more open and the fresh cracks marked C. appeared. The wall sunk about 2 inches on the south side, and not quite so much on the north side. Remarks by the Executive Engineer.— This mode of giving footings to foundations is a mean between those shown in Nos. 1 and 4, which were all green masonry 19 and 15 days old.
2	6' x 2'	2' x 2' x 2' 2½"	4' 6"	3 months and 2 days old.	1st class Akra bricks and mortar composed of two of soorkee to one of lime.	20    18    1    16·53	Wide Sketch No. 2.
3	6' x 2'	2' x 2' x 2' 1½"	4' 6"	15 days.	1st class Akra bricks composed of two of soorkee to one of lime.	27    1    1    12	Wide Sketch No. 3.



## The Gazettes.

### PUBLIC WORKS DEPARTMENT.

**Burma, December 8, 1888.**

With reference to *Gazette of India*, Public Works Department Notification, dated the 12th October 1888, Mr. H. C. Jones, Assistant Engineer, 2nd grade, reported his arrival at Rangoon on the forenoon of the 3rd December 1888. His services are placed at the disposal of the Superintending Engineer, 1st Circle, for employment in the Pegu Division.

With reference to *Gazette of India*, Public Works Department, Notification, dated the 12th October 1888, Mr. A. G. R. Trapmann, Assistant Engineer, 2nd grade, reported his arrival at Rangoon on the forenoon of the 6th December 1888. His services are placed at the disposal of the Superintending Engineer, III. Circle, for employment in the Mandalay Civil Division.

**Madras, December 11, 1888.**

The following promotions are made :—

Lieutenant-Colonel R. R. E. Drake-Brockman, R.E., Superintending Engineer, 3rd class, sub. *pro tem.*, and Superintending Engineer, 2nd class, temporary rank, to Superintending Engineer, 3rd class, permanent rank, with effect from 20th November 1888.

Lieutenant-Colonel R. R. E. Drake-Brockman, R.E., Superintending Engineer, 3rd class, and Superintending Engineer, 2nd class, temporary rank, to Superintending Engineer, 1st class, temporary rank, with effect from 20th November 1888.

Colonel W. H. Burton, R.E., Superintending Engineer, sub. *pro tem.*, 3rd class, to Superintending Engineer, 2nd class, temporary rank, with effect from 20th November 1888.

Mr. W. Hughes, B.A., Executive Engineer, sub. *pro tem.*, 1st grade, to Superintending Engineer, 3rd class, temporary rank, with effect from 20th November 1888.

Captain W. D. Lindley, R.E., Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, permanent rank, with effect from 20th November 1888.

The following transfers are ordered :—

Rai Bahadur Amrito Lall Roy Chowdry, L.C.E., Executive Engineer, 2nd grade, from the 3rd Circle, No. III., Tank Party, to the 1st Circle for charge of the Ganjam Division.—To join from privilege leave.

Mr. J. Inglis, Assistant Engineer, 1st grade, from the 6th Circle, Negapatam Division, to the 1st Circle, Vizagapatam Division.

The following postings are ordered :—

Mr. H. T. Keeling, Assistant Engineer, 2nd grade, to the Periyar Project Works.

Lieutenant W. M. Ellis, R.E., Assistant Engineer, 1st grade, to the 6th Circle.

**Punjab, December 13, 1888.**

Mr. E. E. Taylor, Assistant Engineer, 3rd grade, is promoted to Assistant Engineer, 2nd grade, with effect from the 6th November 1888, the date on which he completed a year's service in the 3rd grade of Assistant Engineer.

#### Irrigation Branch.

Mr. J. H. Brooke, Executive Engineer, 4th grade, temporary rank, from the 2nd Division, Bari Doab Canal, which he left on the forenoon of the 6th November 1888, to the 1st Division, Bari Doab Canal, which he joined on the afternoon of the same day.

Mr. R. D. Bayley, Executive Engineer, 1st grade, from the Office of Superintending Engineer, Derajat Circle, which he left on the afternoon of the 1st November 1888, to the Dera Ghazi Khan Division, Indus Canals, of which he took over Executive charge from Mr. R. A. Molloy, Executive Engineer, on the forenoon of the 3rd idem.

**Bombay, December 13, 1888.**

Khan Bahadur Pestonji Hormusji Patuck, B.A., L.C.E., is appointed to act as Executive Engineer, Ratnagiri and Kolaba, during the absence of Rao Bahadur Gopal Raoji Tilak, L.C.E., on privilege leave, or until further orders.

**N.-W. P. and Oudh, December 15, 1888.**

#### Irrigation Branch.

Mr. W. A. Francken, Executive Engineer, 3rd, grade, has been granted by Her Majesty's Secretary of State for India one month's furlough, in extension of the furlough granted him in Notification, dated 12th June 1888.

Mr. F. Reilly, Assistant Engineer, 1st grade, sub. *pro tem.*, is transferred from the Nadrai Aqueduct Division to the Etawah Division, Lower Ganges Canal.

**India, December 15, 1888.**

Captain J. Burn-Murdoch, R.E., Executive Engineer, 3rd grade, State Railways, is appointed to officiate as Deputy Consulting Engineer for Railways, Bombay.

The services of Mr. T. H. Wickes, Officiating Chief Engineer and Joint Secretary to the Government of the North-Western Provinces and Oudh, Public Works Department, are replaced at the disposal of the Government of Bengal with effect from the afternoon of the 5th December 1888.

Mr. H. W. Bennett, Officiating Deputy Consulting Engineer to the Government of India for Railways, Calcutta, has been granted furlough for six months by the Secretary of State for India, in extension of the furlough for nine months granted to him in Public Works Department Notification, dated 20th March 1888.

The transfer of Mr. C. H. C. Bickerton, Executive Engineer, 3rd grade, sub. *pro tem.*, State Railways, to Establishment under the Government of Madras for employment on Railways in that Presidency, which was notified in Public Works Department Notification, dated the 22nd October 1888 is hereby cancelled.

#### Military Works Department.

Captain J. E. Dickie, R.E., Executive Engineer, Umballa Division, Military Works, is appointed to the charge of the Dagshai Division, Military Works, in addition to his own duties, during the absence of Captain E. C. Stanton, R.E., Executive Engineer on Field Service.

#### Director-General of Railways.

With reference to Public Works Department Notification, dated 5th December 1888, Lieutenant Herman Bonham-Carter, R.E., Assistant Engineer, 2nd grade, is posted to the North-Western Railway.

**Bengal, December 19, 1888.**

With reference to the terms of the Resolution of the Government of Bengal, dated 6th December 1888, the Lieutenant-Governor is pleased to sanction the formation of a temporary division in the South-Western Circle, to be called the Damuda-Rupnarain Survey Division, with the object of enquiring into the causes of the floods in the tract of country lying between the Damuda and the Rupnarain rivers, in the districts of Burdwan and Hooghly, and into the possibility of finding a remedy.

Mr. O. C. Lees, Executive Engineer, has, on return from furlough, been placed in charge of the division.

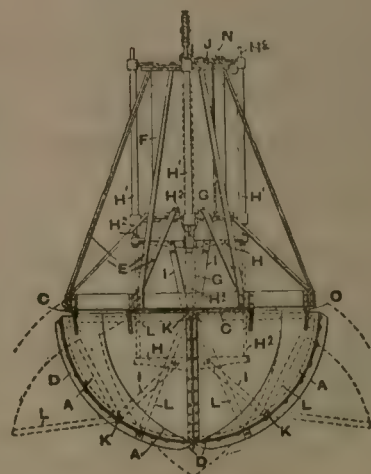
#### Irrigation Branch.

Mr. J. P. Coy, Assistant Engineer, has been granted by Her Majesty's Secretary of State for India an extension of ten months' furlough.

## Indian Engineering Patent Register.

### RECENT AMERICAN PATENTS.

**DREDGING BUCKET.**—*S. N. Knight, Sutler Creek, and I. P. Lambing, Ione, California.*—This bucket is opened and closed by the action of some fluid in the cylinder F. The cross arm H is attached to the piston rod G, and is guided by the rods H<sup>1</sup>. The links I are attached



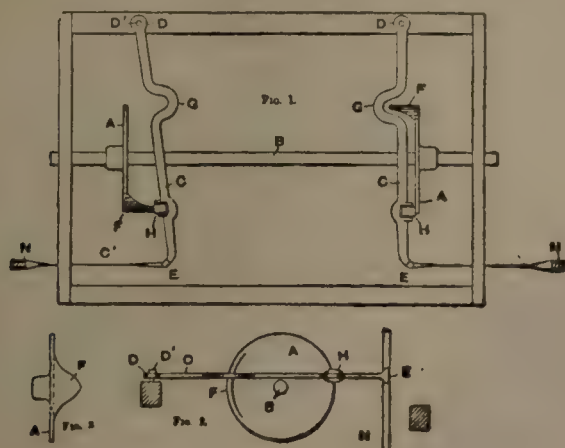
to the cross arm H and to the ends of the segmental buckets K. These segmental buckets are hinged to the ring B, which is carried by the frame work E. Three claims are made.—No. 385759. July 10th 1888.

### RECENT BRITISH PATENTS.

**PICKER MOTION FOR LOOMS.**—*H. J. Allison, London. (H. Sawyer, Boston, and R. S. Douglass, Plymouth, Mass., U. S. A.)*—The improvements relate to the mechanism for communicating motion to the shuttle from the mechanism of the loom. B is the driving shaft



carrying the discs A furnished with swells F, the shape of which is shewn more clearly in Fig. 3. C C are levers pivoted at D to the frame of the loom, and cranked at G to allow of the passage of the



cam swells F. The free ends of the levers C carry loops E, to which are attached straps C', which are also connected to the picking sticks N. The levers C, at the point where they come in contact with the cams, may be furnished with rollers H. One claim is made for the combination of the apparatus described.—No. 8924. June 19th, 1888.

## Advertisements.

D. P. W. India.

## IMPORTANT NOTICE.

All Civil Engineers of the Department are informed, that, owing to the extended support accorded to the Civil Engineers' Association, the Committee feel it necessary to still further widen their sphere of influence, and to delegate some of their duties.

The current work has been entrusted to Local Sub-committees, who will correspond with the Central Committee.

Every Civil Engineer is urged to write to the Hon. Sec. c/o Grindlay, Groom and Co., Bombay, who will put him in touch with his Sub-committee, with the view of enrolling him a member of the **Civil Engineers' Association.**

## SOUTH INDIAN RAILWAY, VILLUPURAM-DHARMAVARAM EXTENSION.

### To Petty Contractors for the Supply of Labour and Building Material, &c., &c.

1. About 300 miles of new Railway construction have been started from Villupuram through Teriyannamali, Vellore, Chittoor to Tirupati and Dharmavaram.

It is intended to carry out the work as far as possible on the Departmental or Petty Contract system, and the attention of Petty Contractors for Labor and Materials is invited to the undertaking.

2. Proposals will be received and information given as to work, rates, &c., &c., on application to the undersigned or to the Engineers on the works.

### To Upper and Lower Subordinates.

3. Subordinates such as Sub-Engineers, Masonry Inspectors, Surveyors, Supervisors, Overseers, and Maistries, well experienced in works of Railway Construction are required. Applications should be forwarded prepaid to the undersigned, giving age, race, full details of experience, reference to previous employers, copies of certificates, salary last or now received and expected.

DAVID LOGAN,  
CHIEF ENGINEER,  
South Indian Railway.

CHIEF ENGINEER'S OFFICE; }  
TRICHINOPOLY; December 8, 1888. } (215)

## SOUTHERN MAHRATTA RAILWAY.

AN Assistant Foreman wanted for the Carriage Shop. Salary on probation Rs. 130, on confirmation Rs. 140; applications with copies of testimonials, which will not be returned, should be addressed to the undersigned.

C. P. WHITCOMBE,  
LOCO. AND CAR. SUPDT.

HUBLI; }  
December 12, 1888. } (219)



## NOTICE.

**TENDERS** are invited for painting about 6,000 tons of ironwork on girder bridges. Tenders should reach the office of the undersigned not later than the 15th of January 1889. The work to be completed by the 1st May 1889.

G. VIBART,  
FOR AGENT & CHIEF ENGINEER,  
*Southern Mahratta Railway,*

DHARWAR :  
12th December 1888.]

*Dharwar.*  
(218).

## "THE NAHAN SUGARCANE MILLS."

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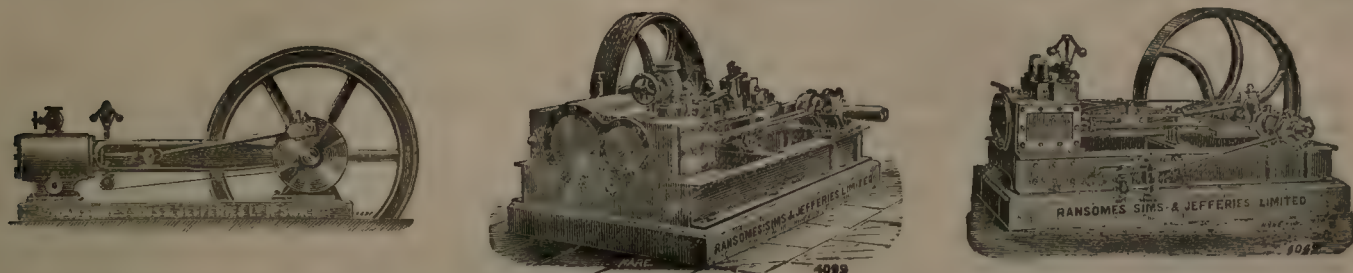
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Losses after deducting Re-insurances ..	£138,365 0 0
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The Life Fund was increased during the year by £65,648 and now amounts to £1,070,064.

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the uncalled Capital of £2,250,000.

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(39)

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General correspondence, and all communications bearing upon literary matters, should, as heretofore, be addressed to PAT. DOYLE, C.E., Spence's Hotel, Calcutta.

It is particularly requested that all letters on business concerning subscriptions and advertisements be addressed to the "Managing Agents," MESSRS. BALMER, LAWRIE & Co., 103, Clive Street, Calcutta; and all remittances be made payable to them.

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## NOTICE TO ADVERTISERS.

THE scope of this Journal makes it aspire to become the only thoroughly useful and trustworthy means of communication between the Profession and those who supply its wants. It should prove useful alike to users of machinery, engineering and building plant, or materials, and to the engineering trades generally, including manufacturers or importers in this country.

An object has therefore been to obtain for its columns special recognition as the best medium for ENGINEERING ADVERTISEMENTS in India. We use the word "India" advisedly since our circulation is not confined to any particular locality or province, but is pretty equally distributed all over the country.

It is hoped that the Profession will utilise the Journal more largely for making known its requirements, and the Editor's co-operation may always be relied on, should it be needed, for such purposes.

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## ANSWERS TO CORRESPONDENTS.

"FAIR PLAY" (K. P. M.)—If this correspondent, who has omitted his address, would call upon us, we could shew him several discrepancies in his statements, which render his letter unfit for publication.

# INDIAN ENGINEERING.

SATURDAY, DECEMBER 29, 1888.

## TO OUR READERS.

IN a few days more our Journal will have completed the second year of its existence, and the large and wide circulation it has attained during this comparatively short period is, we believe, without a parallel in the annals of the Indian press. If the success of a newspaper is gauged by the extent of its distribution, as compared with other journals in the same field of labor, we may well congratulate ourselves on our success. The gratifying testimony of the esteem in which we are held by the Profession, and the unquestionable value placed on our opinions, indicate an assured position. We have thus been able to fight successfully against a Government subsidy, and the principles which have guided us in the past will regulate our policy in the future. To meet the wishes of our friends we have resolved to reduce the price of a single copy of the Journal to 8 annas henceforward, and we hope that that will not be the only change to benefit our supporters—to whom we offer our sincere thanks with the compliments of the season and best wishes for a long acquaintance.

## THE MADRAS HARBOUR.

### I.

IN December 1875 His Royal Highness the Prince of Wales attended by two Dukes and a glorious company of men laid a memorial stone on the beach at Madras to mark an important epoch in the history of the Presidency town, namely, the commencement of the construction of a Harbour which should render the Madras surf a thing of the past. The design of the Harbour was by Mr. William Parkes of Westminster, and the cost of it was to be 57 lakhs of rupees. The work was to be completed in 5 years from the date of commencement. Mr. James May was the Engineer in charge, assisted by Mr. N. Beardmore, with Mr. G. Lowe as head Foreman, all appointed at Mr. Parkes's recommendation by the Secretary of State for India. Mr. Bhemaya Sacuna, a very able Sub-Engineer from Kurrachee Harbour, was also appointed in India.

The works were commenced roughly before the necessary plant and materials had arrived from England, by tipping a bank of laterite into the surf to form the starting point of the North Pier. Unfortunately the first start was a "false" one, as it was found that the bank was being tipped across the mouth of a main sewer outfall. In February 1876 another start was made in the right place, and all went well till in May of that year the Superintending Engineer, Mr. James May, died. In July 1876 the Secretary of State appointed Mr. F. N. Thorowgood as Superintending Engineer and he took charge in August 1876.

In December 1876 the actual construction of the concrete piers was commenced, and with the exception of



most serious and aggravating obstacles caused by travelling sand in 1877-78, the work was pushed on with great vigour till November 1881 when the two piers were practically completed, leaving an entrance 550 feet wide open to the eastward. The two pier-heads were not completed at this date, but the eastern opening was no wider than was intended in the completed design. At this date, sailing vessels of the smaller type used the Harbour freely, and two large vessels with 3 masts were with ease moored in the still water enclosed by the piers. Thirteen screw moorings were fixed with buoys attached, and there seemed to be every prospect of having a permanent little Harbour with sufficient and safe moorings. Railway lines were commenced on the beach, and two low jetties taken in hand to accommodate large cargo boats. The old iron screw pile pier standing some 21 feet out of the water, was to be cut down to suit the altered state of the sea at Madras. All this work had been carried out under the superintendence of Mr. Thorowgood in 5 years, and within the estimate of 57 lakhs of rupees. The Governor of Madras, Sir Mount Stuart Grant-Duff was in hopes that one of his first acts as Governor would be the opening of the Madras Harbour, and some newspapers in India went so far as to hint that there might soon be a "Sir" William Parkes in existence.

On 12th November 1881 a cyclonic storm of some violence (the degree of violence being still a favourite topic of dispute) practically destroyed the whole of the outer portions of each pier, and left nothing standing but the two parts which run out at right angles to the shore. Of the North Pier there remained a length of 2,400 feet standing, and of the South Pier about 2,500 feet. What remained afforded little or no protection to the coast enclosed between, and there was Madras, after an expenditure of over 56 lakhs of rupees, provided with two concrete piers running out from the shore 3,000 feet apart from each other, and at their seaward ends two reefs of artificial rocks with a gap at their most easterly points 550 feet wide, with a depth of 48 feet of water which still serves as an entrance and exit for the vessels calling at the port.

It might be supposed that the most important thing to be done after this storm of November 1881 had practically annihilated the protection afforded by the piers, would be *at once* to do something towards restoring or removing the ruined walls; that the most important condition to avoid was leaving the ruins exposed in all their bareness as a source of danger and a monument to a failure. Yet more than 7 years have elapsed since the disaster of 1881 and the Harbour is very nearly in the state in which the storm of November left it.

It will be well to glance at what has occurred between November 1881 and December 1888 and see if we can find a satisfactory explanation of this apparently unwarrantable delay or neglect. It was universally allowed after November 1881 that Mr. Parkes's design had been weighed in the balance and was found wanting. No one had a doubt about that, not even Mr. Parkes himself

we believe, although he was not ready to admit so much. In January 1882 Mr. Parkes arrived in Madras and proceeded to recommend a restoration of the ruined piers on a similar (though slightly stronger) section to that which had failed. The Governments of Madras and of India however did not see the force of this, and a reference was made to a Committee composed of Sir John Hawkshaw, Sir John Coode, and Professor Stokes as to the best form of pier for the restored work. They went thoroughly into the matter, obtaining local information from Mr. Thorowgood (who proceeded to England in February 1882 on medical certificate), Mr. Parkes and Mr. Dalrymple, formerly Master Attendant, Madras. This Committee recommended a very much stronger section of pier, protected with a screen of 30-ton blocks 28 feet wide on the sea side. Their report reached Madras in February 1883, where, during 1882, Mr. N. Beardmore (then in charge) had been busy making concrete blocks for *Mr. Parkes's design of restoration!* And now began the trouble and delay which has already extended over 2 years more than the construction of the works occupied, and which does not appear to have got a termination in sight at present. On the arrival at Madras of Sir John Hawkshaw's report a strong feeling was got up (and by those whose opinion was of value) that the easterly entrance to the Harbour was wrong, and that in order to obtain quite smooth water at all times (the acknowledged aim of the Harbour Works) the eastern entrance must be closed and an opening made either to the south or to the north. Madras has abounded with amateur Harbour Engineers since the flood and some of these believed that because at certain points in the ruined walls no blocks of concrete were visible, therefore they did not exist and to these amateur Harbour Engineers a north or a south entrance seemed already *half made!* In March 1883 the opinions of the Madras authorities advocating a north-east entrance were embodied in a detailed report with plans and estimates, and this was forwarded to the Secretary of State for approval. By him the question of entrance was definitely laid before the Hawkshaw Committee, and by that Committee the north-east entrance was condemned, and the eastern entrance supported, and this was to be a final judgment. This second report came to Madras early in 1884, up to which date nothing had been done to repair the damage of November 1881. In May 1884 Mr. Thorowgood was summoned to England by telegraph to make, in conjunction with Mr. Parkes (still Consulting Engineer), plans and estimates for carrying out the ideas of Sir John Hawkshaw's Committee in detail. This was completed in August 1884, and all was put in readiness for actual resumption of work. Mr. Parkes wrote an elaborate and clear report as to the future plan of work, and as a concession to the advocates of a north-east entrance he pointed out that to form such an entrance it would be far better to restore the work on the original lines and afterwards to take up what stood in the way of a north-east entrance. We believe, and have every authority for stating, that Mr. Parkes never pronounced against a north-east entrance



but always consistently condemned any attempt to prove that such an entrance could be made without first completing the Harbour on its old lines.

### THE NEW INDIAN RAILWAY BILL.

THE new Indian Railways Bill lately passed through the Viceregal Council is, in effect, an amended Penal Code having concern only with Railways and their control. An amended Civil Code too; useful in its way; but useful only as a definition of rights and privileges, e.g., it is thought necessary to state that suitable gates, chains, bars, stiles, or handrails ought to be erected on suitable occasion. Again that when danger exists of a stray tree falling on the traffic line, and obstructing traffic, a Traffic Manager may without trespassing on the inalienable rights of man be allowed to remove the obstacle to his legitimate business. Furthermore that a Railway Administration may—with the previous sanction of the Governor-General in Council—use locomotive engines for its carrying work. Was mediæval law-giving ever more inconsequent and absurd? Again, we are told that the Railway must be “sufficiently supplied with rolling-stock.”

Would any Government—any sane supporters of Railways—go in for a Railway without adequate supply of rolling-stock? It is—it must needs be—the very vitals and bowels of an efficient Railway management. Bogus Companies will of course pooh-pooh the idea; but valid Companies do not. There is, however, another side view of the business, of an attorney-like character. Let the Government of India have the benefit of it, if its Secretaries are able to. Here following are ominous sections from the newest departure in law and order.

When the Governor-General in Council has ordered under the last foregoing section that the use of any specified rolling-stock be discontinued, that rolling-stock shall not be used until an Inspector has reported that it is fit for use and the Governor-General in Council has sanctioned its use.

When the Governor-General in Council has imposed under the last foregoing section any conditions with respect to the use of any railway or rolling-stock, those conditions shall be observed until they are withdrawn by the Governor-General in Council.

A “Law Commissioner” is to be Supreme Judge of the new faculty. What has law in the abstract to do with Railways? Is it at all likely that an abstract Law Lord dutifully given to the details of his own profession, and unmitigatedly ignorant of any pretence even of acquaintance with Engineering, will be able to do anything like tolerably Engineering work or control? *Credat Judæus Apella—non ego.*

It is written—in section 44 of the Report under consideration—“may charge reasonable terminals.” That is Government chaff probably—a commonplace and undignified style of chaff to our thinking. Possibly, however, it pays somebody’s way. Further it is written that “a Railway Administration may charge reasonable terminals.” Wanted, a definition of “reasonable” terminals?

### Notes and Comments.

**RAILWAY MILITARY TRANSPORT.**—A small Conference, to consider questions connected with military transport on Indian Railways, will assemble shortly at Calcutta.

**AN ACKNOWLEDGMENT.**—We have received Vol. XXI., Part 4, 1888, of the *Records of the Geological Survey of India*, the contents of which call for no special notice.

**THE G. I. P. R. Co.**—The Directors of the Great Indian Peninsula Railway Company recommend a dividend for the half-year to the 30th June last of £1 6s. 9d. per cent. in addition to the guaranteed interest of the half-year.

**SELF-EVIDENT CHANGES.**—We learn that Mr. J. T. McIntyre has relinquished the editorial conduct of Messrs Newman and Co.’s organ and that Mr. E. M. Paul has taken his place, thus making the third nomination to that office in less than three years.

**THE INDIAN MIDLAND RAILWAY.**—Colonel Conway-Gordon, Director-General of Railways, will shortly inspect the Indian Midland Railway. The Government of India is not likely to raise any objection to the opening of the line on 1st January.

**RECOGNITION OF SERVICES.**—Thomas Alexander, Professor of Engineering at Trinity College, Dublin, has received from the Emperor of Japan, in recognition of services at the Imperial University of Japan, the Order of the Rising Sun, fourth class.

**B. N.-W. R.**—The total cost of the work, covering all charges, is reported as amounting to £5,600 per mile, spread over the whole. The capital cost, including the flotilla and everything, is £5,383 per mile—that is, about £200 at present short of the total estimate per mile.

**THE PROPOSED EAST COAST RAILWAY.**—Sir Guilford Molesworth and Colonel Smith, Consulting Engineer for Railways, Madras, are now making a reconnaissance from Bezvada northwards, through Vizagapatam, to see whether the scheme for the East Coast Railway is a feasible one.

**RAILWAY SCHEMES IN PROSPECT.**—We hear that it is very probable that Sir John Fowler, the eminent Engineer, who is now building the Forth Bridge, is about to come out to India in connection with some Railway schemes in Madras and Bengal, and that Sir Bradford Leslie will probably accompany him.

**PROSPECTS OF THE COTTON CROP IN THE BOMBAY PRESIDENCY.**—“The latest reports shew the area sown at 973,647, or 3.55 per cent., below the area of 1887-88, but 5.35 per cent. above the average of the four years ending 1887-88. Speaking generally, the decrease is due to the scanty and irregular sowing rain.

**A BAD POLICY.**—The office of the Sanitary Commissioner and Surgeon-General with the Government of India, remains behind at Simla for the first time this Winter. The policy of making Simla the permanent Head-Quarters of the office seems to be growing apace, as there are two offices staying there this cold weather, which never stayed before.

**RECOGNITION OF INDIAN RAILWAYS.**—From the 26th of last month trustees in England were empowered to invest their trust funds in Indian Guaranteed Railway stocks, shares and annuities. These were formerly excluded from the very narrow list of investments allowed by law to trustees; and they will doubtless avail themselves of the extension freely.



**ITEMS FROM MANDALAY.**—Colonel Stover has gone to the Ruby Mines, there to see affairs doubtless in connection with the last decision of Government on the vexed question of Messrs. Streeter's monopoly. Dr. Noetling has gone prospecting for coal and other useful articles, into the North of the Mandalay District, where there are dacoits as well as minerals!

**PROGRESS WITH THE BENTOTA LINE, CEYLON.**—We can hardly say that a commencement has been made with the Bentota line, but we believe great progress in the acquirement of land has been made, and that about a mile and a half of the line beyond the Bentota river has been cleared of trees, so that something is being done. We have every reason to believe that this extension will be carried out very cheaply.

**WORKS OF PUBLIC UTILITY CONSTRUCTED IN BENGAL IN 1887.**—The statement of works of public utility constructed by private individuals in the several districts of Bengal during the year 1887, shews an aggregate of Rs. 2,56,530, which is nearly a half of the figure for 1885, viz., Rs. 4,78,450. The works most constructed are tanks, which number 179 and cost Rs. 1,20,741-10-0, with wells which number 836 and cost Rs. 21,475-0-0.

**RAILWAY EXTENSION IN CEYLON.**—The "first sod" of the Haputale Railway Extension was cut on the 1st instant, without any ceremony, by Mr. T. R. Walker, who has got the contract for the first mile of earthwork from Nanuoya. Contracts are being given to other gentlemen, and work on this extension line is expected to be in full swing by the commencement of next year. The three stations on the Haputale Extension line are to be at Ambawella, Ohiya and Idulgashena, respectively.

**MR. R. F. CHISHOLM.**—This gentleman, who was formerly the Consulting Architect to the Government of Madras, has, we hear, just entered into an engagement to reside permanently at Baroda. We trust His Highness the Gaekwar will make good use of him as an Architect and keep him up to his principle of executing all decorative work in this country. Doubtless the treatment which Mr. Chisholm received at the hands of the Bombay Municipality has hastened his departure from Bombay.

**THE BURRAKUR EXTENSION, E. I. R.**—There is little further information as to the proposed extension beyond Burrakur. Plans and estimates are under revision in connection with a desire to utilize for the bridge certain girders in hand which will become available, and the estimate (to include about six miles of line) will probably be brought below ten lakhs. Further borings are being made in the river bed, but it would be difficult to say at present when the work of constructing the bridge will be commenced.

**DEHRA DUN FOREST SCHOOL.**—The Government of India has read with interest, but with few remarks, the report for 1887-88 of the Dehra Dun Forest School. Briefly, 75 students were under instruction during the year, 56 having been supported by Government, 9 deputed by Native States, and 10 were private students. This is hardly a very satisfactory proportion. The results of the examinations have not been strikingly good; 17 Rangers' certificates having been granted, but none with honors, and 14 Foresters' certificates.

**GOLD-WASHING IN THE PUNJAB.**—Some interesting experiments in gold-washing are being carried out on the Sohan River, near Rawalpindi, by Messrs. J. R. Serrot and D. P. Masson, with the aid of machinery invented by the former. It has been ascertained that gold can un-

doubtedly be washed in paying quantities, if the operations are confined to small selected areas; but this would create but a very insignificant industry, and larger experiments are now being made in milling sand shewing slighter signs of auriferous deposit.

**B. B. AND C. I. R.**—The accounts of the Bombay Baroda, and Central India Railway for the half-year to 30th June last, as passed by Government, show that the company's share of the net surplus, after payment of all working charges and fixed interest on capital, is sufficient for a dividend in January next of £1 6s. per cent., in addition to the guaranteed interest then due, making in all a distribution of £3 10s. per cent., for the half-year, less English income-tax, as against £3 18s. 6d. per cent., paid at the corresponding date in January last.

**THE MILITARY JURIST.**—The Cantonments Bill, recently published in the *Gazette*, affords a striking instance of the incapacity of the military jurist to grasp the most elementary ethical principles upon which legislation is ordinarily based. It also displays an inadequate conception of the foundation of legal rights; but the inexpediency of interfering with such established legal rights when the owners are sufficiently independent of official control, to resent any such interference is, as will presently appear taken thought of by the framers of the Bill with commendable foresight.

**THE FUTURE EDUCATION OF AN ENGINEER.**—The *Engineer*, dated London, 30th November 1888, remarks:—"Under the head of 'Another Scandal,' INDIAN ENGINEERING says—'We learn on good authority that the appointments of Deputy Manager and Manager on Indian State Railways will hereafter only be held by R. E's., and that orders have been actually issued to that effect.' In future the education of an Engineer will have to be—Firstly, Military; secondly, Military; thirdly, Military; and little scrappy Engineering might perhaps be thrown in with advantage."

**DARJEELING-HIMALAYAN RAILWAY.**—The management of the Darjeeling-Himalayan Railway is to be reconstituted from the new year. Mr. Prestage proceeds to Europe and a manager is to take complete charge of the line—the office of Secretary being abolished. Mr. W. R. Stevenson has, it is said, secured an appointment on a new Railway in Central India and does not return to Darjeeling. We hear that Mr. G. E. Moore, Deputy Consulting Engineer for Railways at Calcutta, may take Mr. Prestage's place, and we are certain that no better selection could be made.

**ANOTHER INDUS BRIDGE.**—The difficulties of bridging the Indus at either Dera Ghazi Khan or Dera Ismail Khan are exaggerated. No Engineer of experience in this kind of work would consider the task as differing in its nature from that of bridging the other great rivers of the Punjab. The men who have bridged the Chenab and Sutlej can, if required to do so, bridge the Indus also, and it is probable that utilizing the great experience they have acquired of late years, they would be able to do so at a cost not much exceeding that incurred on the Alexandra Bridge over the Chenab.

**BRIDGE BUILDING.**—Professor Unwin, in discussing lately the subject of theory and practice, has entered into this branch of Engineering science, and holds the view that if in any part of the work of the Engineer, theory has proved a useful guide, it has been in the building of iron girder bridges. Almost every improvement of design has been an attempt to conform more



closely to conditions imposed by scientific reasoning. An iron Railway bridge is, amongst all structures, that in which the conditions of loading are best known, and the quality of the material used most carefully ascertained.

**RECENT FILTRATION PRACTICE.**—Mr. S. Tomlinson, Deputy Executive Engineer, in charge, Water-Works, Municipality, Bombay, has contributed to the American Water-Works Association an elaborate paper on this important subject. Mr. Tomlinson explains the true and desirable object of filtration, and shows how that object is attained in two notable instances in England and India—viz., Bradford and Bombay. Mr. Tomlinson is already well known in connection with his speciality, and the paper before us shews that he has devoted as much attention to "Water Purification" as he has done to the "Prevention of Water Waste."

**A GRAND STRUCTURE.**—The following excerpt will convey some idea of the palatial structure about to be erected as Municipal offices for Bombay:—The grand staircase will be covered by a dome, the walls of which will be carried up in the shape of a tower 180 feet high, crowned by a circular outer dome. The space over the staircase dome will be utilized for a record-room to which a hydraulic lift will be attached. Above this room at a height of 120ft. from the ground will be placed a large Fire Service Tank to command the building. The Council Chamber will be a fine room 65ft. by 32ft. 6in., with a separate carriage entrance.

**IRRIGATION IN THE PUNJAB.**—One of the most satisfactory of all the annual reports that have reached the Government of the Punjab is, we believe, that of the Irrigation Department. Not only have the canals paid working expenses, but they have done more, they have earned four per cent. on the capital outlay. As the money was borrowed at four per cent., this amounts to saying that the canals have been self-supporting during the past year. The indirect good that canals do is of course immense. They develop the resources of the Province, and add to the material prosperity of its people more, probably, than any other works.

**OURSELVES.**—The *Madras Times* does us the honor of extracting some of our articles and items, but at the same time does us the injustice of crediting our rival with the same. We are constrained to refer to this small matter from the fact that our South Indian contemporary offered a labored and apologetic explanation in behalf of our rival under reverse circumstances not long back. We are therefore not a little surprised at finding the descriptive account of Scindiah's Palace at Ujain, which appeared in our issue of the 15th instant, credited to our rival, and more so, as this is not the only mistake of the kind made within the course of a week.

**MADRAS AND SOUTH INDIAN RAILWAYS.**—From the schedules of estimates sanctioned on the Madras and South Indian Railways up to 31st July last and forwarded to the Director-General of Railways, we learn that on the former, twenty-seven works of different kinds were completed, thirty-nine are in progress, three not commenced, and one in abeyance; and on the latter, ten works of various kinds were finished, twenty-nine in progress, and six not commenced. The works are of a miscellaneous character, such as extension of platforms, building of godowns and huts, raising lines, additional sidings, erecting refreshment rooms and the like.

**THE PORT OF CALCUTTA.**—The size and draught of the ships visiting the port continues to increase; last year there were 832 clearances inwards and outwards of vessels drawing over 21 feet, as against 780 in the previous year. There was an improvement in the total tonnage of vessels arriving at, and departing from, the port, and the gross tonnage, 4,466,969, was the largest on record. The above figures are exclusive of 11 light vessels, 16 pilot and 45 other Government vessels, six other vessels and eight steam-tugs which are constantly moving up and down on the river, and also of the steamers trading to the Orissa ports. Of these there were 249 arrivals and 248 departures. Native crafts are also excluded.

**THE DEFENCES OF BOMBAY.**—In referring to the Harbour Defences of Bombay in his speech at the Byculla Club, Lord Dufferin remarked that the works had already made considerable progress and he foreshadowed to some extent further measures for military security which are to be provided. The particular nature of these further works was not indicated, but it appears that the central position of the entire defences is to be at Colaba, where the old light-house tower, after extensive alterations, will be utilised as a conning tower and will be fitted with the most modern range-finding apparatus. It is believed indeed that before next monsoon breaks upon us the defence of Bombay will be an accomplished fact.

**THE HOOGHLY BRIDGE AT CALCUTTA.**—The Bridge was kept in thorough working order during the year. In a report recently received from the Commissioners as to the condition of the Bridge, it was stated that at the present time the perishable part of the structure, with the exception of the planking underneath the road surface, is in all respects in as good a condition as it was on the day the Bridge was first opened for traffic. It has also been reported that materials for replacing the planking underneath the road are already in stock, and that the experience of past years has enabled the officers in charge of the Bridge to take special precautions to prevent decay which has been found in certain parts to be due to preventable causes.

**TRAMWAYS IN THE CITY OF MADRAS.**—These lines are to be worked by steam engines at a rate not exceeding eight miles an hour—engines and carriages to be connected by double couplings, each coupled wheel to be fitted with a brake block, applicable by screw, and treadle; and also by steam. A governor (which cannot be tampered with by the driver) is to be attached to each engine, and will incontinently shut off steam, and apply a brake, should that monster exceed a speed of ten miles an hour. Arrangements are to be made enabling Tramway Drivers "to command a full view of the road" before them. Arrangements that seem likely enough to result in obstructions to road-traffic. But Madras has got a tramway at last, and can probably afford to disregard extraneous considerations therefore.

**MR. F. N. THOROWGOOD.**—We would particularly invite the attention of the Profession to our leading article on the Madras Harbour in this issue, with reference to the treatment received by Mr. F. N. Thorowgood, late Superintending Engineer, at the hands of the Port Trust, or, as it is locally called, "Harbour Board." Mr. Thorowgood, who had ever worked well and was over and over again officially complimented regarding his work, found it impossible latterly to serve with either credit or satisfaction, and so resigned. Before coming to India he had been for 9 years an Assistant Engineer on the



works of the River Tyne Commissioners, where he was engaged on the construction of the piers at the mouth of the Tyne, on dock works and the large swing bridge at Newcastle. He has our sympathy.

**A NEW DEPARTURE IN ROAD-MAKING.**—Some time ago we called attention to the introduction in Ceylon of stone-ware pipe sluices, by which a considerable saving to Government was made. We now learn that these pipes are being used instead of culverts on the minor roads of the Matale District with considerable success and a great saving of money. These pipes are obtained from Messrs. Burn & Co.'s Raneegunge Works, near Calcutta. As the saving to be effected both by the adoption of these stone-ware pipe sluices is great, it is to be hoped that they will come into general use throughout the island, thus allowing of a much larger number of village tanks being sluiced every year than could otherwise be done. We have seen them used for waterways or flood-openings in diversions on Railways here in India.

**LAND ACQUISITION FOR THE BENGAL-NAGPUR RAILWAY.**—A Correspondent writes: "People are speaking of the B.-N. Railway being thrown open for traffic between Purulia and Asansol early next year. If that be the case, the Indian world will be edified by the fact that the land acquired and used for the line has not been paid for, owing to the short-sightedness of the authorities in deputing a comparatively junior native official, with no local knowledge and less of the interests involved, to deal with matters which are altogether beyond his ken." We are disposed to endorse these views. We believe that the Deputy Collector on this special duty has made confusion worse confounded. In one case an opinion had to be obtained from the Advocate-General; and, generally, things appear to be in a nice muddle.

**AMERICAN AND RUSSIAN OIL IN BOMBAY.**—According to the United States consular report of Mr. B. F. Farnham, the sales of kerosine oil from 1st June 1887 to 1st June 1888, were 870,000 cases, of 10 imperial gallons each. Out of this 320,000 cases were American and 550,000 cases Russian; both 125 degrees government test; both put up in cases of two tins of five imperial gallons each. The American oil realized 3.70 rupees per case. Russian oil, 3.50 rupees per case. Quality about the same. Russian oil is very generally used, and the brokers report that Russian oil is expected to come freely on the market here in future. Sun Flake American oil, 150 degrees government test, is sold in smaller quantities at higher price, but the majority of consumers use 125 degrees government test oil, American or Russian.

**OIL ON THE TROUBLED WATERS.**—From a contemporary we make the following extract: "The steamer *Umballa* encountered very rough weather during last week's cyclone. She arrived at Madras with the loss of four boats, her foretopmast and yards. For thirty-six hours the Captain and officers were on the bridge without rest or food. Eventually kerosine oil was used with wonderful effect in breaking the force of the waves. No one suffered personal injury, beyond bruises and cuts. A vessel has been wrecked off Negapatam, but her name has not transpired. A steamer has gone to the spot to try to render assistance." With reference to this effect of oil, we may mention that some light will incidentally be thrown on the case in a short series of articles on "Ship Rolling," which we hope to publish when the articles on "Bicycle Running" have been concluded.

**NO MORE GUARANTEED RAILWAYS FOR INDIA!**—The Lahore paper is informed on good authority that the Secretary of State has at length determined to grant no more guarantees on capital for Railway construction in this country. How long this decision will be adhered to is not of much importance. It is sufficient if it is authoritatively stated that for the present India must find capital for new Railways on some other conditions: and for our own part we are disposed to think that this decision will result in several schemes being brought forward which, up till now, have been held back in the hope of a guarantee. A proposal, for instance, is likely to be made, if not already before the Government, by Sir T. Hope, to make the Chittagong-Cachar line without guarantee, but on the basis of grants of land alongside the line and a monopoly of the coal and oil deposits in the Cachar Hills. The Delhi-Kalka line is another which is being floated without guarantee, and which we hope may be successful.

**BOMBAY GAS COMPANY.**—The Report of the Directors of the Bombay Gas Company, Limited, furnishes a statement of accounts audited for the half-year ended 30th June last. Compared with the corresponding half of last year, the revenue from the sale of gas and meter rental shews an increase of £1,102. The receipts from the sale of coke, tar, and fittings are also satisfactory. The loss in exchange on £32,000 remitted during the half-year was £14,974, the average rate being 1s. 4½d. per rupee. Of this loss £8,474 has been charged to profit and loss, and the balance, £6,500, written off to exchange equalisation account, leaving £1,979 at the credit of the latter account. The amount at the credit of profit and loss is £8,859 10s., which, with the balance brought forward, £156 10s., makes a total of £9,016. Out of this sum the Directors have placed £500 to the credit reserve fund for depreciation of plant, &c., and declared an interim dividend of 3½ per cent., amounting to £8,400, leaving £116 to be carried forward.

**TRAFFIC ON N.-W. R.**—The approximate return of traffic for the week ending the 3rd of November 1888, on the North-Western Railway, from all sources amounted to Rs. 5,29,070, that for the corresponding week of the previous year being only Rs. 4,26,994; thus shewing an increase of rather over Rs. 1,00,000. By far the larger portion of this increase was derived from "Merchandise and Mineral Traffic." Taking the gross traffic earnings for the 18 weeks ending the period named above as against the corresponding period of the previous year, the increase amounts to Rs. 22,00,000 approximately—the figures being Rs. 83,97,505 and Rs. 62,01,947 respectively. Here again the increase occurs chiefly under the same head, the improvement under "coaching" being only Rs. 2,00,000, taking round numbers. These results are doubtless highly satisfactory, and although they are in the main due to the late movement of troops and stores, &c., on the frontier, yet there is a sufficient margin left to shew, that the Railway is making very satisfactory progress in respect to traffic earnings.

**TRAMWAYS IN SOUTHERN INDIA.**—Proposals having been addressed by Mr. D. E. W. Leighton, to the Madura District Board regarding the construction of a Steam Tramway line on the Ammayanayakanur-Periyakulam Road, the Board has resolved to permit the necessary local investigations in connection with the construction of a Steam Tramway line between Ammayanayakanur and Periyakulam within six



months. Should the Board, feel satisfied as to the feasibility of the line, they will finally decide on its construction by the Company he represents, and guarantee interest at  $2\frac{1}{2}$  per cent on the capital expenditure. Proposals having also been made to the Tanjore District Board for the construction of light lines of Railway on existing roads in the District, the Board has replied that it is willing to afford information regarding the traffic between Tanjore and Tiruvadi, and to grant a concession to construct a Tramway, and to work it on the road between these two places, subject to such future arrangements as may be agreed upon as to the regulation of traffic; but is not prepared to guarantee interest on the undertaking.

**MR. I. J. WHITTY.**—This gentleman's engagement as General Manager of the Bengal Coal Company will terminate with the end of the year. Having already given publicity to some facts and figures relative to Mr. Whitty's management of this large concern, it will suffice for us to say that within the period of his office the outturn of the Company's collieries has increased by more than 30 per cent., while its shares have risen by no less than 50 per cent. in the Calcutta market. These achievements speak for themselves, and are only what would be expected by one who shewed, as far back as 1876, that the East Indian Railway Company's collieries at Giridhi were capable of an out-put of 1,000 tons a day. But we believe that Mr. Whitty will be better remembered in India as a Railway Engineer, his work on the Darjeeling (Mountain) Tramway being that which first brought him into Professional prominence and by which he made his mark. He has been upwards of 20 years in India, and now intends going home, possibly never to return to the country where he has many friends and well-wishers who would be glad to welcome him back.

**A GRACIOUS ACT.**—The Chairman of the Bengal and North-Western Railway Company at the last half-yearly meeting of the Directors paid the following tribute to the late Mr. Rhind :—"The other event is a more sad and serious one. Our Locomotive Superintendent, Mr. Rhind, had been to Calcutta on the business of the Company and had returned to his head-quarters at Gorakhpur just in time to hear of the flood damages I have just referred to. He set off with the Traffic Superintendent to the spot, got out of the train, was walking to the damaged bridge, when he suddenly fell back on the ballast and almost immediately expired. Mr. Rhind's professional ability, systematic method, economy in working, and his management of the staff renders his loss a very serious one to the Company. He had the complete confidence of those serving under him, and his loss is to be deeply regretted. I may mention that one of the works for which we are indebted to him is the putting up of our flotilla, which he built on the bare banks of the Ganges in a most satisfactory and economical manner, saving us what would have been a heavy expense in the employment of an Engineering firm to do the work."

**THE BOMBAY FACTORIES.**—The Bombay Millowners, at a meeting held on the 19th instant, decided that the Secretary, assisted by a Committee, be appointed to prepare a memorial, setting forth the different conditions of factory labor in England and India, shewing how unnecessary and inapplicable the English Factory Act would be for Indian Mills; pointing out how such a legislative measure would be a source of hardship to adults by reducing their earnings, and the manner in which it would be the means of preventing thousands of

young persons and children from earning their livelihood; respectfully calling to mind the sacrifice that India was compelled to make in the interests of Lancashire in repealing the import duties; and, lastly, pointing out that factory legislation in the direction agitated for by the Lancashire competitors is meant, and would tend, to cripple an industry which it is the best interests of the State to foster and encourage by every legitimate means; the progress of cotton and kindred manufactures in India being the only true safeguards against famine and want in the country, which is otherwise dependent on agriculture for the people's support.

**UPPER BURMA LOCAL ALLOWANCES FOR MEMBERS OF THE P. W. D.**—The Government of India has sanctioned from 1st October 1888 the following Upper Burma allowances :—

Superintending Engineers on pay not exceeding Rs. 1,100 ... ..	Rs. 100
Executive and Assistant Engineers, of all grades... ..	100
Engineer Apprentices ... ..	50
Examiners, classes III. and IV. } ... ..	100
Deputy and Assistant Examiners } ... ..	100
Apprentice Examiners ... ..	50
Sub-Engineers, all grades ... ..	80
Accountants, 1st and 2nd grades ... ..	80
Accountants, 3rd grade ... ..	60
Supervisors, all grades ... ..	60
Overseers, all grades ... ..	40
Accountants, 4th grade ... ..	40

Sub-Overseers and clerks not engaged locally and not on consolidated rates of pay, 30 per cent. on salaries varying from Rs. 30 and upwards, subject to a maximum allowance of Rs. 40; and 50 per cent. on salaries under Rs. 30, subject to a maximum allowance of Rs. 8. Somewhat similar allowances have also have been sanctioned for Railway Officers and Subordinates employed in Upper Burma.

**IRRIGATION IN THE BOMBAY PRESIDENCY.**—The Irrigation Report for the Bombay Presidency, exclusive of Sind, for the year 1887-88, has just been issued. The area of land irrigated during the year was 46,187 acres, an increase of 3,559 on the previous year. The working expenses came to Rs. 2,44,385 and the revenue realised Rs. 3,43,445, giving rather more than Rs. 7 per acre. If in addition to this revenue the value of the water supplied to the station and cantonment of Poona from the Mutha Canal and of other water supplied, either gratuitously or at reduced rates, be added, the earnings will amount to Rs. 4,18,810. The net revenue after deducting all charges, amounts to Rs. 1,05,127. The irrigated lands have produced chiefly wheat, sugarcane and rice, bajri and groundnut. Over 3,000 acres are laid down as gardens and orchards. The most valuable crop is the sugarcane, the area of which under irrigation is steadily increasing. Mr. J. E. Whiting, the Chief Engineer, is of opinion that the reduction of the water-rate which was resorted to in 1883-84 with the view to encourage the irrigation of land has not had the desired effect. The extent of land irrigated depends upon the amount of the rainfall. He recommends that the experiment of low rates should be abandoned, and a new scale provided. On some of the canals the water is not utilised, although the land is suitable and the supply of water abundant. The cultivators are looking forward to a revision of their assessments, and they hope to escape enhancement by neglecting to make profits by irrigating their land.



## Current News.

ABOUT 300 prisoners were despatched from the Lahore Jail for Multan to work at the Chenab Bridge.

On return from furlough, Major C. H. Brookes, R.E., is posted to Fort William Division, Military Works.

It is practically settled that the duty on silver plate will be removed within the next two or three months.

It is expected that the working of forests in India will yield a net revenue of 41½ lakhs of rupees for the year 1888-89.

LIEUTENANT R. F. ALLAN, R.E., Military Works, Fort William, is transferred to Phulta to take charge of the defences there.

MR. BARLOW, Chairman of the Madras Harbour Trust, has asked Government to allow him to withdraw his resignation.

COLONEL CONWAY-GORDON, Director-General of Railways, will arrive in Jhansi on the 3rd January for the purpose of inspecting the line.

COLONEL LE MESURIER will represent the Public Works Department at the Conference of the Railway, Military and Transport officials.

As regards the transfer of Sind to the Punjab, it is said that the Government of India has disallowed the claim of Bombay for the loss of territory.

SERICULTURE is to be commenced in the Chingleput District, Madras, where the cocoons in the neighbouring forests were found to yield the best silk.

On Colonel Jackson's arrival in Baluchistan, Captain A. C. Bruce, R.E., is transferred from Sibi Division to the Allahabad Division, Military Works.

COLONEL WALLACE, the Director of the North-Western Railway, left Lahore for Calcutta in connection with the proposed Railway Military Transport Conference.

A DECISION in regard to the selection of an automatic Railway brake for India, which was to have been declared on the 19th instant, has been postponed till the 2nd proximo.

A SCHEME for the re-organization of the Meteorological Department has been under consideration, and the new arrangements will be brought into effect from the 1st of January.

It has at last been definitely arranged that the Indian Midland Railway Company shall take over the working of the Bhopal State line from Bhopal to Itarsi on the 1st of January.

A NUMBER of Italians who were brought out for work on the Mysore mines, have given every satisfaction to their employers, and proved themselves quiet and industrious workmen.

At the end of this year the editorship of the *Indian Forester* changes hands, Mr. W. R. Fisher, who has conducted it since July 1882, handing it over to Mr. E. E. Fernandez, Deputy Director of the Forest School.

In consideration of the want of water in the Rajkot civil station, it is now proposed to devote Rs. 87,000 out of the lakh raised in remembrance of Her Majesty's Jubilee, to a scheme of water-works to be termed the Jubilee Water-Work.

MR. MOOLJEE LILADHUR SHAH, a successful candidate in the last Bombay L. C. E. Examination, is the first member of the Moolh Bania community, and also the first inhabitant of Porebunder to take his degree in the University.

MR. T. H. DE LA TOUCHE, of the Geological Survey of India, who had gone to Padra (a mountainous district of Jammu beyond Kishtwar) to make mineralogical explorations in those tracts, has returned to the Punjab by Murree, having concluded his season's investigations.

MAYMYO is gradually losing its claims to be considered a sanitarium. Of late it has been one of the sickliest stations in Burma, and its drinking water is so bad now, that 28lbs. of extra wood is daily provided to the troops to boil their drinking water, this having been ordered by the medical authorities.

COMPETITIONS were lately held at Madras at the Saidapett College Farm. Four different kinds of cheap ploughs competed, Messrs Manney and Co. taking the prize of Rs. 200; while seven sugarcane mills, costing not more than Rs. 100 each, competed, and Messrs. Gordon, Woodroffe and Co. took the prize of Rs. 200 for their Shanks' patent mill.

PLANS and estimates (amounting to about Rs. 2,00,000,) of a new drainage scheme for Kombakonum have been approved, and the Municipal Council has been directed to take measures for putting the work in hand and to submit proposals for raising the necessary funds. Government wish the disposal of this matter to be expedited, as the work is evidently urgently required.

## Letters to the Editor.

*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]*

### IRRIGATION IN THE PUNJAB.

SIR,—I beg to send you herewith a rough sketch map\* of the Punjab illustrating the proposed extension of the Canal System in the Province.

The double broken line across the Sutlej, a little above its confluence with the Beas, with canals on both banks, shows the proposed weir at Hurreekes. It may be there is only enough water for the supply of one canal at this point, which should therefore be on the right of the river to supplement the Bari Doab Canal.

The double broken line marked No. 2 shows a second weir in the Sutlej at a point near Mailsie in the Mooltan District, with canal on the left bank; but as this canal would affect the Bahawalpore State only, that State would of course bear the cost of construction.

The line marked No. 3 indicates the proposed excellent site for a weir and feeder canal from the Chenab at Cheniote. This would supplement the present Chenab Canal under construction, and tail into the head of the Sidhnai Canal at Serai Sidhoo.

The line marked No. 4 indicates the probable site for a weir and canals on both banks of the Indus at Kalabagh. The irrigation of this dry, arid, sterile tract along the left bank would be of enormous benefit to the cultivators and Government alike. And if a canal could be taken down the right bank, the benefits to all would be equally great, as there is scarcely any rainfall at all in this parched district.

No. 5 indicates the probable position of a second weir in the Indus near Zeia, or perhaps a better site would be near Kulachie, which would not supplement the canals taking out at Kalabagh; but probably would entirely relieve the Cantonment of Derah Ishmael Khan and Derah Ghazee Khan of the destructive erosive action of the river at these points as well, and thus save the annual outlay on protective works for the two Cantonments alluded to. Surely these would be no trifling advantages, and would be purchased cheaply at a considerable expenditure.

No. 6 indicates a probable site for a third weir in the Indus at Mithenkote the point of confluence of the five historical rivers of the Punjab, with canals if possible on both banks.

No. 7 indicates a probable site for a weir and canal from the Koorum river, taking out as high up as possible, the higher up the better for flow irrigation.

No. 8 on the sketch indicates a possible fourth site for a weir and canal, taking out from the Indus about Sukkur, thus utilizing almost the entire volume of this mighty river instead of permitting it to flow like a stream of molten silver aimlessly and uselessly to the sea.

The foregoing is merely a very rough outline sketch of what it is firmly believed to be quite feasible in canal extension in the Punjab.

E. B.

### "FAIR PLAY" AND "ANTI-HUMBUG".

SIR,—It occurs to me that the issues between yourself and your rival may be reduced to two heads—

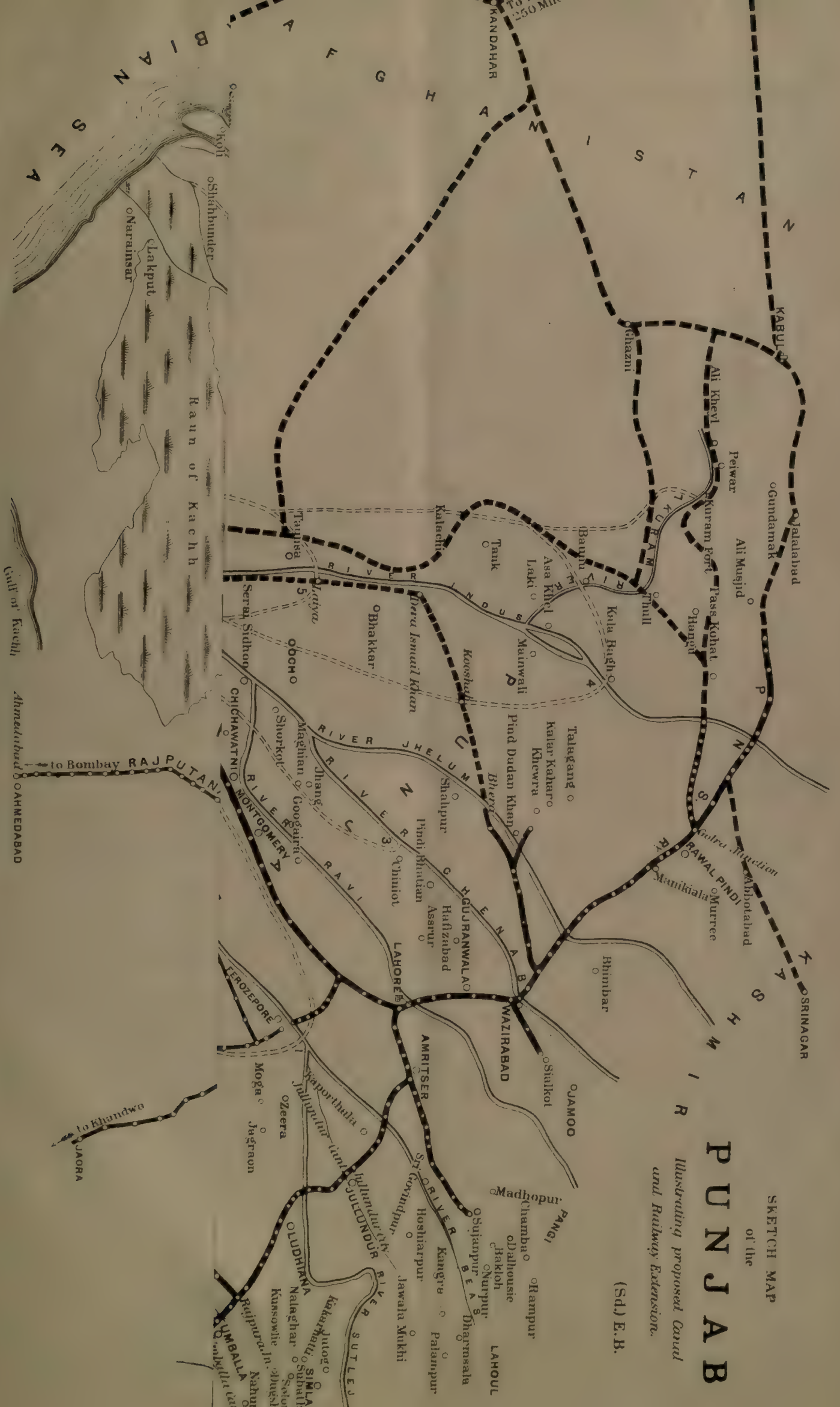
- (1) the Subsidy, and
- (2) the C. E. Association.

Referring to the first, no one will dispute that Government is at liberty to subscribe to any paper it may choose for the use of its servants; but as you allege that this was not a spontaneous action on the part of Government and that it was brought about by misrepresentations made in Messrs. Newman and Co.'s appeal for help, it behoves that firm, for its own credit, to come forward and disabuse the public mind by simply publishing the "appeal" in question. Let me add that no matter how, and in what manner support is accorded, there are implied obligations in the fourth, as well as in the next before, estate of the realm.

As regards the second, your rival might leave the parties most concerned, the C. E.s. of the P. W. D., to decide which of the two organs is friendly disposed towards them, and when in this respect a body of gentlemen are taxed with being blind, unfair or one-sided, and these supposed failings are proclaimed aloud to the world at large, the friendly motives that are claimed to underlie such action become questionable. But what is worse, all this noise and exposure are made over the proceedings of an Association which are strictly "Private and Confidential!" You correctly observed that Messrs. Newman & Co.'s organ had no justification, morally or otherwise, to give publicity to the private correspondence between the Secretary of the Association and its individual members, and the only reason that I can assign for the course adopted by your rival is—to elicit sympathy—and, perhaps, obtain a renewal of the subsidy.

SPECTEMUR AGENDO.





# PUNJAB

Illustrating proposed Canal  
and Railway Extension.

(Sd.) E.B.







## "PRIVATE AND CONFIDENTIAL."

SIR,—I do not care to enter into a lengthy correspondence on the merits of "Fair Play" or "Anti-Humburg's" contention. All that I would say is that your contemporary has not the shadow of an excuse to make our Circular a matter of public comment. He should at least credit us with knowing what we are about. Had we addressed it to him and asked for an expression of opinion, he would have been justified in delivering an opinion. But since we have nothing to do with him or his connection, it is rather hard for him to go out of his way to read us a lecture on what we are to do or not to do. We have studiously kept aloof from him for reasons best known to the service, and all the "twaddle" in propitiating us goes for nothing. Then "Fair Play" also writes a private letter to the Editor of that journal that he betrayed no confidence in sending him copy of that Circular. This is a *ruse* which the service will understand without an explanatory note. All his attempts to induce the service to forsake you will prove abortive. The movement was dictated by no party, either one way or the other, but merely to safeguard our interests; and as your paper has all along espoused our cause, I do not see any reason why we should not help you in your efforts to do us justice. Any one who has observed the policy of your rival will not fail to arrive at the conclusion that he has persistently sacrificed our interests to those of the R. E's., trying to shew that the latter have rendered eminent services to India and are therefore entitled to the loaves and fishes of the service, while we, who have borne the heat and burden of the day, are to be left out in the cold. Even with all these attempts at propitiating the R. E's. has he succeeded in swelling his subscription list? No; the object of his coarse laudation has scouted him, and he had no other alternative but to beg a subsidy from Government whose obedient and humble servant he is. Not through the Bengal Government, the usual channel of such communications, but by a direct appeal to the Government of India. We know what all this means. That same paper is careful to announce to the world that he stands on his dignity (?) Well, will that journal be good enough to tell us if it is at all a dignified duty to make public a private and confidential Circular which was not addressed to him? If the Civil Engineers wished, they might have sent him a copy of the Circular, but as they have not done so, good faith has been broken. I have neither the time nor the inclination to go into these matters, but all I will say here is, let your rival organ inform the profession as to the number of his *bona fide* paying subscribers, irrespective of the Government subsidy ones, and compare it with your list. It will shew at a glance which of the two journals deserves success and the support of the Engineering service.

C. E.

## THE FIRST TRIPLE EXPANSION ENGINE IN INDIA.

SIR,—It may interest your readers to learn that on the 6th instant the first triple expansion engine in India was started at a new cotton mill in Aurungabad. It is an engine of 400 indicated horse-power working with steam, supplied at 150lbs. pressure, from Babcock and Wilcox's patent safety boilers. The start was effected without either hot bearings or hitch of any kind; an unusual circumstance when the novelty of the machinery is considered.

The engine is of the horizontal type, with a horizontal condenser, and the cylinders have diameters of 16, 18 and 34 inches, respectively. The revolutions are 70, and the piston speed 700 feet per minute. The power is transmitted by means of cotton ropes to the shafting.

The boilers do not contain a piece over 2½ tons in weight, a most important consideration where they had to be carried along 54 miles of road after leaving the Railway, and across some 50 bridges, many of which would not support the weight of a Lancashire boiler without propping.

The Babcock boiler has a grate area large enough to burn the poorest of Indian coal, and is peculiarly adapted for the application of forced combustion, should it become necessary. It is likely to have an important future in India on account of the steadily increasing vogue of high working pressures.

The engine, along with the rest of the machinery of the new mill, was supplied by Norrie, Mitchell and Co., of Bombay, and the mill was built to the design of Mr. John Wallace, C. E., of the same town. The above firm is under contract to supply similar machinery to the Baladina mill at present in course of construction in Bombay, the engines in this case being vertical instead of horizontal.

The economy of space obtained by using the vertical type of engine will be best shown by the following figures. The Aurungabad horizontal engines, 400 H.P., have a floor space of 66 feet by 22 feet, while the Baladina 500 H.P. vertical engines have a floor space of 22 feet by 28 feet only. In towns where land is of high value the compactness of the vertical type will be a very strong recommendation.

The compound double expansion engine seems destined, before many years are past, to be replaced by the triple expansion, and in some cases by the quadruple expansion engine, with a proportionate increase of working pressure. The economy of the

latter types has been so clearly proved in many ocean steamers which call at Indian ports, that their adoption in Indian mills will follow rapidly on the success of the first examples.

The high steam pressure necessary with the new type has perhaps had its effect in deterring timid people from adopting the most modern means of transforming fuel into power. This is in a certain measure the fault of their mechanical advisers, who are not always as well informed as they might be, on the effects of heat and pressure in boilers.

Researches and experiments of the most exhaustive kind made by Mr. Daniel Adamson over a period of fifteen years have set all doubt at rest on the question of high pressures, both as regards their safety and their economy.

Wrought-iron and steel at very low temperatures become so brittle as to become quite useless for structural purposes. At very high temperatures, say from 2,550° Fahr. to 2,910° Fahr., they are liquids. Between those extremes there is a point of temperature at which the metal has the greatest cohesive strength, and this point is now recognised to correspond with a temperature of 450° Fahr. The steam pressure corresponding to this temperature is 390 pounds per square inch, so it is evident that iron and steel continue to increase in strength up to a temperature far beyond that of the highest steam pressure at present in use. The following small Table of Pressures and corresponding Temperatures will place the matter clearly before your readers:—

Pressure per square inch.	Temp. Fahr.
100 ... ..	338°
150 ... ..	366°
200 ... ..	388°
250 ... ..	406°
300 ... ..	422°
390 ... ..	450°

It is thus evident that a boiler constructed according to existing rules for a working pressure of 150lbs. per square inch is less likely to give way from weakness of material, than another boiler built for and working at 70lbs.

On the economy of fuel and water with the higher pressures and increased expansion of steam, it is unnecessary to dilate. The fact is universally admitted.

BOMBAY; December 14, 1888.

J. W.

## DEPARTMENTAL RE-ORGANIZATION.

## II.

SIR,—As the necessary strength of a Public Works Department in India must be continually varying with the policy of Government and the fluctuating expenditure on Public Works, it must ever prove a practical impossibility to regulate it with perfect accuracy; but much good might be done in this direction if it were a rule to make an annual forecast of requirements 10 years, or 5 years at least, ahead, and to recruit accordingly. Experience has shewn that it is detrimental to the direct interests of the State to make sudden large additions to, or reductions in, the Department; the one sooner or later causes stagnation in promotion, and deranges its regularity, inducing discontent and a weakened morale, while the other entails extra expenditure in gratuities and pensions. When expansion or contraction are unavoidable, they should be extended over as long a period as possible.

2. It is, however, a question whether it would not be better to keep the strength of the Department at a permanently low average, engaging temporary men to fill the less important posts, and thus to set free their permanent occupants, when a temporary increase in expenditure necessitates the employment of more Engineers. The temporary men would be discharged when the pressure of work diminished.

3. As regards the proportions to be observed between the numbers in the Imperial and Provincial Services, it should of course be the aim of Government to keep down the strength of its more expensive service to the lowest limit consistent with efficient supervision and control. This will be greatly facilitated by putting control into the hands of the Imperial Engineers much earlier in life, and investing them with greater responsibility, and greater freedom than is accorded to the Department at present. As "Veritas" has already forcibly drawn attention to the desirability of a great reversal of policy in this direction, I will not enlarge on it here. It should, however, be supplemented by an assurance of greater certainty that efficient men shall realize their hopes of rising to the higher posts.

4. At the age of 28, a gentleman, being an educated and highly trained Engineer, should be fit to control a large division, at 38 he should be fit to superintend a circle, and at 45 to administer a province. To keep highly educated gentlemen doing junior and less responsible work for years and years after these ages, as is at present the case, is neither true economy nor fair to the men themselves.

5. A Service of Imperial Engineers, entrusted with greater freedom and increased responsibility, accorded a wider field for earning distinction, and imbued with a reasonable hope that individual merit would obtain sure recognition by promotion to positions of still higher responsibility and trust, would be capable of



controlling a larger area of work than the Government scheme contemplates. The actual execution of the work being, under their extended supervision, carried out mainly by the Provincial Service, the relative proportion of Imperial to Provincial Engineers might be safely reduced. With a total strength of 800, half at least might be Provincial, and half Imperial, including the 80 Chief and Superintending Engineers' posts, all of which should most certainly be reserved for the Imperial Service.

6 The salaries of the Provincial Service should be fixed with a view to its eventually being largely recruited from the better classes of natives; it is believed that the scheme now suggested is such as would meet their requirements. It should also prove sufficient for the class of Anglo-Indians and Eurasians who, with an Indian education and training, would seek admission to the service; these it must be remembered would not, as a rule, be members of the upper classes, most of the latter being sent to England in early childhood to be educated.

7 Assuming then that the Imperial Service is to consist eventually of 80 Chief and Superintending Engineers, and 320 others, the minimum service spent in the superior posts would be one fifth of the whole period of a 33 years' career, or say from the age of 48 to the age of 55. But taking into account casualties and the impetus given to retirement by better promotion and pension rules, it is probable that the average age at which all might hope to reach the rank of Superintending Engineer would be nearer 45, while a really efficient officer might fairly hope to climb up the ladder at the rate of progression given in the following scheme :—

IMPERIAL.	Duties.	Ages. From To.	Ranks.	Pay.		Ranks.	Ages. From To.	Ranks.	Pay.	Ranks.	Ages. From To.	Duties.
				Rs.	Rs.				Rs.			
	Provincial Administration (10 years).	48-50	Chief Engineer, I. Class	2,500	2,500	Executive, 1st Grade	50-55	Executive, 1st Grade	900	Divisions (11 years)		
		45-48	" II. "	2,200	2,200	" 2nd "	44-50	" 2nd "	750	Small Divisions and large Districts (4 years)		
		42-45	" III. "	1,900	1,900	" 3rd "	40-44	" 3rd "	600			
	Circles (7 years).	38-42	Superintending Engineer, I. Class.	1,500	1,500	Assistant, 1st Grade	35-40	Assistant, 1st Grade	450			
		35-38	" II. "	1,250	1,250	" 2nd "	30-35	" 2nd "	350			
	Large Divisions (10 years)	32-35	Controlling Engineer, 1st Grade	1,000	1,000	" 3rd "	25-30	" 3rd "	250			
		28-32	" 2nd "	750	750	" 4th "	22-25	" 4th "	200	Districts (8 years)		
	Small Divisions and large Districts (3 years)	25-28	" 3rd "	500	500	Apprentice, Entry to		Apprentice, Entry to	150	" Attached."		
	Small Districts and " Attached" (3 years)	22-25	" 4th "	350	350							

8. The following rough calculation is intended to shew the relative cost to Government of the proposed scheme as compared with the present state of things. It is meant to give a fair average case under each system, but it is unfortunately purely theoretical, as I have no statistics from which to ascertain the present rate of advancement of an officer with an average career. I have, however, endeavoured to be on the safe side by taking a

low average in illustration of the present state of things, and a high average for the proposed scheme.

AS AT PRESENT.			AS PROPOSED.					
Months.	@	Amount.	Months.	@	Amount.	Months.	@	Amount.
	Rs.	Rs.	Imperial.			Provincial. (Omitting Ap- prentices under 22.)		
				Rs.	Rs.		Rs.	Rs.
2x12	350	8,400	3x12	1,200	12,000	8x12	200	7,200
2x12	400	9,600	5x12	500	30,000	5x12	250	15,000
3x12	500	18,000	6x12	750	54,000	5x12	350	21,000
3x12	600	21,600	7x12	1,000	84,000	6x12	450	32,400
4x12	700	33,600	4x12	1,250	60,000	6x12	550	43,200
5x12	800	48,000	8x12	1,500	54,000	5x12	700	45,000
7x12	950	79,800	2x12	1,900	45,600	3x12	800	32,400
3x12	1,100	39,600	2x12	2,200	52,800			
2x12	1,350	32,400	1x12	2,500	30,000			
2x12	1,600	38,400						
....	1,800	....						
....	2,000	....						
....	2,500	....						
33 years' total ..		3,29,400	33 years' total ..		4,23,000	33 years' total ..		1,96,200

9. Assuming that for every two men employed under the present system, there would be, under the proposed system, 1 Imperial and 1 Provincial, we have the following comparison :—

At present, 2 men @ 3,29,400, earn in 33 years ... 6,58,800  
As proposed, 1 Imperial earning 4,23,000 } would cost... 6,19,200  
and 1 Provincial earning 1,96,200 }

giving a saving, in every 33 years, on every 2 men, of... 39,600  
and on 800 men (400 Imperial and 400 Provincial) in 33 years of ... 1,58,40,000

equivalent to an annual saving, on salaries alone, of ... 4,80,000  
or nearly 5 lakhs of rupees, besides the considerable saving in pensions which would also ensue, but which I cannot attempt to work out.

10. I venture to hope that this scheme may be criticised, or a better one suggested, in your paper; and that suggestions may be offered as to the best way of carrying out the changes necessarily leading up to the form which the Department is finally to assume, and which have not been touched upon in my two letters.

POUNDS.

P.S. Assuming that in an Imperial Service, of which 80 are Superintending and Chief Engineers, and the remaining 320 Controlling Engineers in four grades, all officers enter at the age of 22 and serve for 33 years to the age of 55, it is evident that, neglecting casualties, a Controlling Engineer would be promoted to Superintending Engineer at the age of 48·3 years, i.e., on completing  $\frac{2}{3}$ ths. (= $\frac{2}{3}$ ths) of his whole service. Casualties, from death and premature retirement, however, would, it has been assumed (*vide* para. 7 *ante*), reduce the age from 48·3 to 45. Thus there would be 320 Controlling Engineers of ages varying between 22 and 45. Supposing that they were being promoted as follows :—

From 4th to 3rd grade, at the age of 25  
" 3rd " 2nd " " " " 30  
" 2nd " 1st " " " " 37  
" 1st grade to Superintending Engineer at the " " 45

(a rate of promotion which tallies very nearly with the scale laid down in my scheme) they would each have served as Controlling Engineer for 23 years, viz., 3, 5, 7, and 8 years in the 4th, 3rd, 2nd, and 1st grades, respectively.

If, therefore, the 320 Controlling Engineers were distributed among these grades in the proportions of  $\frac{2}{3}$ rds,  $\frac{1}{3}$ rds,  $\frac{1}{3}$ rds, and  $\frac{1}{3}$ rds, respectively, the service would be in a normally healthy condition, and a constant and regular flow of promotion would be obtained. Taking these fractions of 320, we obtain as nearly as possible the following actual numbers in each grade to ensure steady promotion at the rate proposed :—

4th grade	3rd grade	2nd grade	1st grade	total
40	70	100	110	320

This ratio gives a distribution of 210 men in the two upper grades to 110 in the two lower, being nearly as 2 to 1.

The proportion between Executives and Assistants, in paras. 7 and 9 of the Government scheme, is  $\frac{1}{3}$  and  $\frac{2}{3}$ , or nearly  $\frac{1}{2}$ ; but



I am convinced that this ratio will not produce a satisfactory rate of promotion, and that my scheme, while effecting an annual saving of nearly 5 lakhs, is a fairer and more rational one.

#### "DIRECTORY OF INDIAN RAILWAY OFFICIALS."

SIR,—Allow me to point out the gross errors in one system alone in the List furnished by the opposition journal.

I refer to the "B. B. and C. I. R. including R. M. S. R."

In the B. B. and C. I. R. the Storekeeper's and Traffic Manager's names are incorrectly given, while the Auditor's is mis-spelt. In the R. M. S. R. the Resident Engineer's and Auditor's names are incorrectly given, while the Locomotive Superintendent's is mis-spelt.

Such gross ignorance of current affairs is inexcusable; but when I add that such a simple matter as the working of the Cawnpore-Achnera Provincial line by the "B. B. and C. I. R., &c.," System is mis-represented by your would-be Professional contemporary, I might well say—

*O tempora! O mores!*

#### ROOM FOR IMPROVEMENT.

SIR,—My recent experience has given me a perfect dread of travelling long distances by Railway. The way packages are thrown about in the goods sheds by "porters" is enough to cause one a thousand rupees loss in a week. Even my steel trunks by Jones and Newton and Shakespear have got dinged. Cannot some enterprising Engineering firm combine the qualities of the strongest light wooden boxes, and steel trunks? Say teak to prevent dinging, and thick tin inside and outside to keep off rats and white ants.

OLD SUB.

#### A HARDSHIP.

SIR,—Permit me through the aid of your popular Journal to point out some of the grievances under which the subordinates of Madras suffer. Education through the aid of Missioners has become so cheap that poor native lads are boarded and educated for a mere trifle. Some of these lads join the Engineering College, and after the usual course pass out as Engineers; but are not appointed as such but as Supervisors and Sub-Engineers, thus barring the door to old and deserving subordinates who have spent the best part of their lives in the Department, and who on joining expected that in course of time they would rise in the subordinate grade, find at the tail end of their service they are still at the bottom of the ladder. This will be seen by a glance of the last classified list, where it will be found men who joined the Department 20 years ago are Overseers and Supervisors still.

The putting of young men over the heads of old subordinates affects the prospects of Military men more so than Civil subordinates. In this way that Military subordinates get the pension of their Military rank: and that by Code rule a Warrant Officer cannot attain to the Commissioned grade unless he first attains the rank of Sub-Engineer, which it is almost impossible if young graduates fill the vacancies that occur in higher grades. Now this is a real hardship and a breach of good faith on the part of Government towards those who joined the Department before 1870, before B. C. E's. were appointed to the subordinate grade. The Military men who joined prior to the above year joined on the understanding that as vacancies occurred they would in their turn be promoted to the Commissioned grade, find after they had served ten years a proviso entered in the Code that they must first attain the rank of Sub-Engineer. As this is almost impossible for reason above stated, most of the Military men have to retire as Sergeants and some as Sub-Conductors.

The following are the names of Military men who have retired:

Sub-Conductor Smith	} Joined the Department 1869.
Sub-Conductor Pearson	
Sergeant-Major Willis	} Joined 1868. Sub-Conductors, but
" " Pain	
	rank retired as Sergeants-Majors.

The above-mentioned were all comparatively young men, with 21 years' Military service, but finding their prospects affected by the code rule retired.

Suppose a similar rule made with reference to the R. E. officers, that unless they attained the Superintendent Engineer grade they would not obtain the rank of Colonel. What a yell there would be, and yet it was one of those very R. E. officers who as Chief introduced the proviso in the Code! This question I am afraid will have to be laid before the Commander-in-Chief before anything like justice is likely to be obtained.

AN OLD SUBORDINATE.

MADRAS, 17th December 1888.

#### EARTHQUAKE EFFECTS.

SIR,—It may interest some of your readers to know that besides destruction of houses, cracks, the rude tests to which tall masonry and other structures are subjected to know how far they are elastic, and other unmistakeable signs of an earthquake, there was another one that I noticed here, and that was the bubbling up of sand.

Along the shelving bank of the Nullah that flows past Nattore miniature craters of sand were noticeable scattered over a distance of about 100ft. and numbering more than a dozen, all within a breadth of 15ft. or so, and lying in the north-easterly direction. These craters or bubbles were from 2' 6" to 2" in diameter, the bigger ones being closer to water, the sand thrown up being of the consistency of treacle, and a distinct appearance of sand ejected from one central passage was retained; those formed a little further from water, (hence in comparatively dry soil) were smaller, the mouths were well formed extending to about six inches below the surface, and a quarter of an inch in diameter.

It is not so much interesting to find them of different sizes, because the same force may cause a larger quantity of sand to bubble out in a soft sandy soil than in a hard one, but it was more interesting to note the direction on which they lay, and the fact that they were due to an earthquake shock.

I may also remark that the coolies who were working near the spot, and who were the first to notice them, said that a smell of sulphur was given out, but how far that is correct I cannot say, as I was too late on the spot.

A. E.

NATTORE; 25th December 1888.

#### Literary Notices.

REPORT ON THE PROGRESS AND CONDITION OF THE GOVERNMENT BOTANICAL GARDENS AT SAHARANPUR AND MUSSOORIE, FOR THE YEAR ENDING 31ST MARCH, 1888.

LAST year the Botanical Gardens at Saharanpore went in largely for experiments in which Mexican wheat, fodder plants, textile plants, medicinal plants, experiments with gypsum, and other scientific endeavours were conditionally made amalgamate. With reference to textile plants, the authority concerned writes now that "the outturn was less than in some former years owing to the heavy rains in July" etcetera, etcetera. Why could not the Editor of the Report have set down explicitly that Indian—germane—seeds are better suited to Indian soil and climate than any possible changes of the North American moon can possibly be? Why not try to regenerate, to give new life to the old-world engrafted garden religions that are still a heritable tradition amongst Hindoos, instead of reducing it to a mere give and take account.

What are called medicinal plants have not fared well, e.g., the testimony of Mr. Stansfield, Manager of the Arcadia Tea Estate, Dehra Dun. He says "I regret to say that the coca plant you were kind enough to send me has not stood the winter well. I had it planted outside and carefully looked after, and shaded overhead with a horizontal *tatties* on a frame-work and occasionally watered by hand. The frost has been unusually severe this winter and the coca plant felt it severely. All the small branches are frost-bitten and the main stem only shows signs of life near the root. I fear the plant won't thrive in the Dun. I will watch it and let you know if it recovers. I have my doubts, as the twigs are dry and snap if bent." Coca in India is a snare and delusion. The sooner well intentioned men can be diverted from it, and men like Mr. A. O. Hume diverted into it, the better it will be for the country at large.

We are treated with the selfsame old manure story of ten years ago: gypsum is held to be still king of manures. We are glad to hear that the paper mulberry (*Brossonetia papyifera*) has developed a healthy ambition and vigorous attainment. But we quite fail to see for what good cause and reason this Blue Book, we have been considering, should have been allowed to deliver itself in print at public expense.



## General Articles.

### THE INDUS BRIDGE AT SUKKUR.

WE present our readers this week with two views of the Sukkur Bridge, one a general view of the bridge taken in September, and one shewing the operation of hoisting the pieces of the Inclined Tie, witnessed by the Delegates from the Railway Conference on their way through Sukkur to the Brake Trials, as described in our issue of 27th October.

In the general view, the barge is shewn at the end of the cantilever receiving on board a piece for hoisting, which has been rivetted upon the floor and is being rolled out. The platform in the trestle on the barge is adjustable to any height, so as to suit the rise and fall of the river. After the piece has been received on board, the barge is washed out clear of the line of the Tie, and the piece lifted into position by the erecting gear. This consists of a steel wire rope of 36 tons breaking strain, fastened to one cantilever and passing over a large pulley in the galleons on the opposite one, to a special winch with a large drum driven by worm gear.

There are a pair of these ropes to each side of the bridge, and both being furnished with a travelling pulley, a third rope attached to the piece draws it to its place, while winding the main ropes raises either end to any height required.

The winches are driven from a countershaft just under them by two belts, one straight and one crossed, working on loose pulleys, with a fast pulley between them, and the countershafts are driven by a running rope 375 feet long from an engine placed away behind at the foot of the back guy.

When a lift is to take place, the engine is set going, and any winch is independently started, stopped or reversed by the man in charge, at a signal from the barge. Only at the final operation of adjusting the piece to the exact fit of the rivet holes, handles are put on, and the finishing touch of perhaps a quarter of an inch given by hand.

### BICYCLE RUNNING.

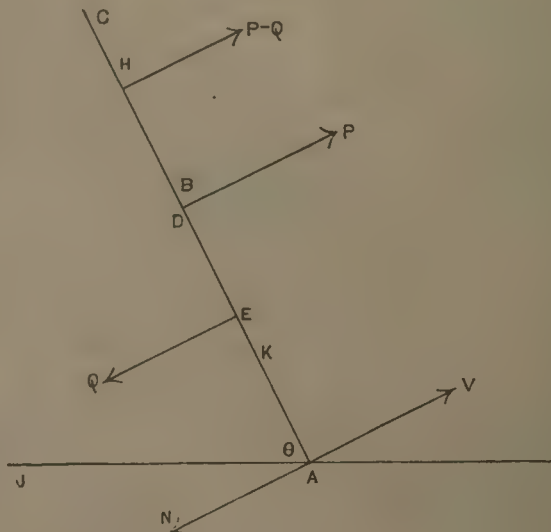
By A. EWBank.

X.

WE left the bicycle in what we called a bad way with one part of it trying to pull the other on its back so to say. If we seem to wander from the subject, our wanderings are only apparent. Let a bicycle stand upright in the meridian with a rider sitting straight and looking north. Let the bicycle and rider be moved as one rigid body about the line joining the lowest points of the wheels. Let the complex body composed of bicycle and rider be thus made to incline to the meridian at an angle  $90^\circ - \theta$ . Thus  $\theta$  is the same angle as we had originally. Let the bicycle slope to the left as seen by a spectator standing behind it, or south of it. Let the bicycle wheels have no rotation. The bicycle may then be replaced by a rectangular lamina of wood, iron, or other material, and the rider, in respect only of his mass, may be replaced by a mass of some substance. If the ground is smooth the bicycle will slip. We suppose the ground to be rough, and so rough that in the movements we are about to consider there will be no slipping. If the bicycle falls or moves at all, each point of bicycle or rider moves in a vertical plane, normal to the meridian. This plane as previously stated is called a prime vertical. As the movements are entirely of this east and west character—as far as their horizontal components are concerned—we may replace the bicycle by a bar of iron, and the rider by another bar of some material, and may consider the motions of these bars in one plane only, viz., the prime vertical. The mass that represents the man is to be compared, not to a rigid bar, but to a bar which may flex or bend at times. Moreover, the contact

between the two bars is not at one section only. For in the real bicycle the man has one leg on each side and he can with either leg exert pressure on the machine. We are at present omitting the really more important action of the hands.

Fig. 10.



In fig. 10 A B represents the bicycle and C B represents a part of the rider. The rider is supposed at the moment to endeavour to save himself from falling. He accordingly exerts some pressure on the bicycle with one or with both legs. We shall, as stated in the first instance, suppose him not to use his arms. If he only presses with one leg, then he only receives a re-action from the bicycle, a single force. This force is to carry him, or his C G, eastwards or to the right hand as seen by the spectator, already mentioned. The re-acting force must in direction be such a force as P in the figure, and not such a force as Q.

Now P does so what is required in respect of its action on H, which is the C G of the man. But while carrying the man towards the east it gives him a counter-clockwise rotation about H, because the point D somewhere in the man's leg is under H, the man's centre of gravity. But this rotation is not what the man does in fact wish and need to give himself. His rotation must be clockwise.

Thus no single force represents the re-action of the bicycle on the man, or the action therefore of the man on the bicycle in this case when the man grips only with his legs. We need, therefore, another force Q, and this force due to the action of the other leg must not be in the same direction as P. For a second force like P would give as resultant a single force also like P. Thus Q must act as in the figure. The motion of translation of the man is then due to P—Q.

The motion of rotation about H measured clockwise is dependent on

$$Q \cdot H E - P \cdot H D.$$

Let this moment be called L and let P—Q be called R. Then,

$$Q \cdot H E - P \cdot H D = L \\ Q - P = -R$$

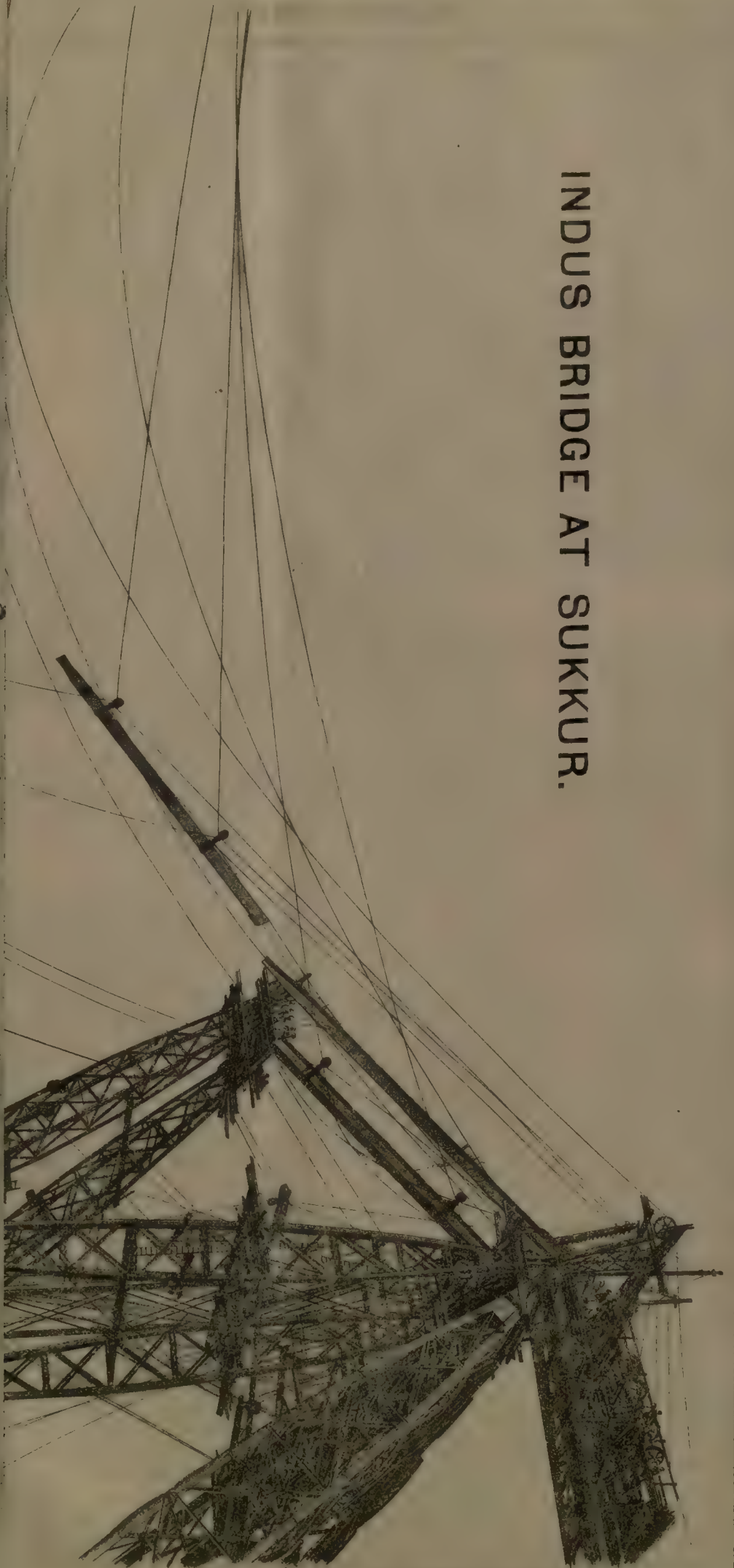
If we consider the points D, E to be given and also L, R to be known, we have two equations for the unknown forces P and Q. Thus,

$$(H E - H D) Q = L + R \cdot H D \\ (H E - H D) P = L + R \cdot H E$$

Thus we get positive values for P and Q so that they act as drawn in the figure. We may, therefore, conceive the possibility of the man by quick muscular actions of his two legs moving more to the right hand, and at the same time obtaining a more upright position. He presses with his right leg at some point D. He



# INDUS BRIDGE AT SUKKUR.









presses with his left leg with less force, but at a point lower down.

The only other force in the man is his weight which acts through H and has no rotatory efficacy. The flexibility of the bar may for a man who only uses his legs be supposed only to be needed at the place B, as the man's legs may keep close to the bicycle. Now let us consider the bicycle as distinct from the man. On the bicycle the force P is reversed in direction and similarly for Q. Thus we have a large force P acting downwards and leftwards with a smaller force Q acting upwards and rightwards and nearer to the point A. Therefore, the gradual or impulsive rotation of the bicycle must be counter-clockwise, or such as removes it still further from the upright position. This rotation is assisted by the weight of the bicycle acting through K, its centre of gravity, as the weight has a moment about A.

If we consider P and Q as impulsive forces, they produce in a short time an angular velocity  $\omega$  in the bar or bicycle. If  $k$  be the corresponding radius of gyration and M the mass of the bicycle.

$$M k^2 \omega = P \cdot K D - Q \cdot K E$$

where we take moments about a horizontal axis, due north through K, the centre of gravity. Also if the velocity caused to K by P and Q be  $u$

$$M u = P - Q$$

In the last two equations we are leaving out of account the weight of the bicycle as a force. The point A will travel towards N in virtue of the translation velocity  $u$ . It will travel towards V in virtue of the angular velocity  $\omega$ . The real motion of A as depending only on P and Q will thus be, if measured towards V

$$\omega \cdot K A - u$$

If this be positive, then the movement of A as due entirely to P and Q is towards V. Such a movement is equivalent to one vertically upward and one horizontally east or to the right. If the point A does not leave the ground, there will be a resisting friction acting towards J in addition to any other force that for other reasons may act along A J.

If, however,  $\omega \cdot K A - u$  be negative, the tendency of A as due only to P and Q is to move towards N. In this case a re-acting force acts upwards and to the right. This is an external force acting on the complex mass, bicycle *plus* rider. The C G of the whole mass is carried to the right and is also lifted, and these are just the results after which the rider is striving. If P and Q are impulsive or great forces, we are entitled to ignore the weight of the bicycle because this is a slow acting force. Hitherto we have supposed the bicyclist only to use his legs. Let us now suppose him to use also his hands. Let the action of one hand and of one leg be the force P which is still under H. Similarly, let Q be as in the figure. We thus assume that the action of a leg is so powerful compared with that of the corresponding arm that the resultant of these forces is under the man's centre of gravity. Then this case is algebraically and dynamically the same as before. This also includes the case of one hand being used feebly and the other not at all.

Thirdly, let the man use his hands more powerfully than his legs or feet. The handle grip is in fact better adapted for such a lateral action as we are contemplating, than is the grip of a foot on a treadle.

Then the resultant of the hand and foot action—the foot action as a special case being zero—may lie above H.

A force P acting above H is sufficient to carry H to the right and also to induce the proper rotation in the man's body. We, therefore, do not need Q. In considering the action on the bicycle we may have Q zero as a special case or even directed like P. Q however will be numerically less than P in all cases. Thus in all cases we are led to consider the sign of  $u - \omega \cdot K A$ .

Now suppose that without altering the total weight of the bicycle and without giving the wheels any rotation we were to arrange smaller wheels concentric with the

bicycle wheels and so managed that these smaller wheels could rotate without the real bicycle wheels rotating. This we could do by having an axle rigidly fastened to each bicycle wheel, and on such an axle putting two smaller wheels, one on each side of the bicycle wheel. We could even manage so, that the centre of gravity of the bicycle was in the same place as before. Then this bicycle placed at the same slope  $\theta$ , and having the four extra wheels not touching the ground and rapidly rotating, would be easier for the rider to keep up than is the bicycle whose whole mass was unrotating.

But the consideration of the bicycle with unrotating wheels was only a step to the discussion of the bicycle in ordinary movement. Let, therefore, the bicycle indicated by *fig. 10* have a forward movement, its wheels being in sufficiently rapid rotation. The velocity of the machine is at the moment in the meridian, while the motions that we have discussed are in planes normal to the meridian. We can therefore ignore the meridian velocities until it suits our purpose to remember them. Even if we had velocities normal to the meridian—the bicycle varying its slope  $\theta$  before the rider put into action the forces P and Q—we can still examine by themselves the new velocities due to P and Q, subject of course to the necessity of properly combining them when they are found with those pre-existing velocities.

Similarly, we were justified in considering the action on the bicycle of certain forces P and Q by themselves.

For suppose the rider makes no attempt to save himself from falling, the wheels having no rotation as in the former case. Then if he falls as being rigidly connected with the bicycle, this bicycle must exert certain pressures on his body. For, otherwise, he would not rotate about the point A. Conversely he re-acts on the bicycle with certain forces, say R and S. Then the bicycle has its own weight W acting at K. And at A there is an upward vertical force X and a horizontal frictional force Y directed towards J.

These forces R, S, W, X and Y between them settle the movement of the bicycle when the man is as it were inert. He is then simply so much dead weight strapped fast to the bicycle.

Now let him show life and make an effort to avoid falling. Let the forces P, Q which we had in *fig. 10* be not the whole forces between the rider and the bicycle, but the excess forces or the new additional forces which he exerts. Then while leaving R and S to be properly combined with W, X and Y we may treat P and Q as abnormal or exceptional forces and study their effects separately, subject of course to the necessity of combining them with the effects due to the original five forces. Here we are not compelled to declare P and Q to be much more violent in action than the original forces, and with a bicycle in movement and properly managed, P and Q are not impulsive forces.

Thus the motion of A, which we are studying, is the extra motion due to P and Q; this motion measured towards N is  $u - \omega \cdot K A$ . If we could change our bicycle for another, in which the value of  $u$  would be the same, but the value of  $\omega$  would be much reduced, and reduced to any extent that we wished, then we could finally have  $u - \omega \cdot K A$  positive, even although in the bicycle first taken we had  $u - \omega \cdot K A$  negative. If we finally have  $u - \omega \cdot K A$  positive, then we introduce at A an additional movement, and one which is directed towards N. This calls into play an additional ground re-action, and this is directed upwards and to the right. This new force, like all the forces at A, is an external force on the whole mass, bicycle *plus* rider. It moves the centre of gravity of the whole mass to the right and upwards, and so either saves the fall or at least retards it.

In the real bicycle there are two points of contact with the ground. This, however, does not affect our reasonings. The two ground contacts must share between them the pressures which we are, in *fig. 10*, attributing to the one



ground contact A. However, we need not lose sight of the fact that we have two wheels in contact with the ground. We may imagine that in *fig. 10* one wheel hides the other. Let the other touch the ground at a point L. Thus A L is normal to the plane of the paper which denotes the prime vertical, and which contains all the lines indicated in *fig. 10*. The forces which in *fig. 10* are called P and Q act, when reversed in their directions, on the bicycle. We have to consider the moments of these forces about a horizontal line due north through the bicycle's centre of gravity. The velocity  $u$  of the centre of gravity produced by P and Q is still measured downwards to the left. The angular velocity  $\omega$  of the whole bicycle is still clockwise and we still have to consider the sign of

$$u - \omega K^1 A^1$$

Here  $K^1$  denotes the C G of the bicycle and  $K^1 A^1$  is drawn perpendicular to A L to meet this line in  $A^1$ .

Now a rotating wheel will fall as fast through the air as will a non-rotating wheel. It may even fall faster owing to secondary reasons due to air resistance with which we are now not concerned. It will, when falling, yield as readily to side winds as would a non-rotating wheel similarly placed at each moment. In a word, the rotation of a wheel does not change its susceptibility to movements of pure translation. But the rotation does introduce a resistance to change of *direction* of the wheel plane.

Suppose then that we make the experiment indicated in *fig. 10* with a bicycle whose wheels do not rotate in their own planes. The slope  $\theta$  of the bicycle is to be a given quantity. We shall have a certain value for the quantity  $u$  and a certain value for  $\omega$ .

Let us repeat the experiment on a bicycle whose forward velocity is some quantity  $x$  and whose wheels do accordingly rotate. We shall have the *same* value for  $u$  and a *different* value  $\omega - \phi$  for the angular velocity.

Let us again have an experiment when the bicycle's linear velocity is  $x + y$ . We shall still have the same value  $u$  for translation velocity and a still less value  $\omega - \phi - \psi$  for the angular velocity. And the quantity we called  $K^1 A^1$  is a constant of the bicycle. Thus, whatever be the distribution of mass in the bicycle—for on this distribution depends the sign of  $u - \omega K^1 A^1$  for a bicycle whose wheels do not rotate in their own plane—we can always, by giving the bicycle a sufficient forward velocity, insure that  $u - \omega K^1 A^1$  shall be a positive quantity.

In this case the C G of the whole mass, rider *plus* bicycle, will be lifted and moved eastwards by reason of re-acting forces at A and L, which act parallel to A V in the figure.

## MINING IN GREAT BRITAIN. \*

(From our own Correspondent.)

THE evil effects of incrustations in steam boilers is very clearly set forth in the statement that a scale of  $\frac{1}{16}$  inch thick requires the consumption of 15 per cent. more fuel, when  $\frac{1}{8}$  inch thick 60 per cent. more is required, and at  $\frac{1}{2}$  inch 150 per cent. The effect of the extra heat also causes the iron to gradually become brittle and granular. It would therefore appear that where many boilers are in use, a supply of good water would save at least the use of one boiler, and in every case there would be a considerable saving in fuel.

The process of making salt is very crude and simple. The whole secret consists in evaporating the water and retaining the salt, a low temperature being used if coarse salt is required, and a high temperature for fine salt. About 10 cwt. of small coal is used to make a ton of common salt and about 13 cwt. of unscreened coal to produce a ton of fine

salt. Last year, 2,013,529 tons of white salt were produced from brine, in the counties of Cheshire, Durham, Staffordshire, Worcestershire and Yorkshire, and 150,267 tons of rock salt were worked in Cheshire. The exports of salt reached 818,713 tons, of which 323,704 tons were sent to the British Indies, and 118,284 tons to the other British possessions and colonies; whilst the United States absorbed 172,951 tons.

The certified production of the "Mount Morgan" gold-mine in Merionethshire has been recently published; the results are: 1886, *nil*; and 1887, 58 ounces of gold valued at £209 or £3 12s. 0d. per ounce.

The explosives added to the authorized list recently, are: Roborite, a mixture of chlorinated di-nitro-benzol with nitrate of ammonium. Carbo-dynamite is nitro-glycerine absorbed in a specially prepared and absorbent charcoal, in which as much as 90 per cent. of the fluid is safely retained. "Fortis," is a nitrate mixture containing proto-sulphate of iron, from which nitric acid is liberated when exposed to moist air; its use is, therefore, prohibited except in the form of air and damp proof and compressed cartridges. "Arnide" is a mixture of the nitrates of ammonium and potassium and charcoal. The use of "victorite" is not yet licensed.

The use of petroleum motors is being suggested in mines. It would take the form of a gas engine of the locomotive type, the gas being produced from benzine or petroleum. The weight would be about the same as an ordinary locomotive running on the narrow gauges used in mines. The engines of this type run noiselessly and there is little or no smell of oil or gas.

There is a great deal of discussion upon the question of technical education, but there appears to be some difficulty experienced in defining it. Thus a so-called technical work on "Mining and Quarrying" says:—"In order to economise expense, the one shaft must serve for pumping, ventilation, the ascent and descent of the miners, and the bringing of the coal to the pit's mouth." Still speaking of shafts, it says "at every 25 to 30 fathoms a cistern is made in an excavation of the rock, and for that portion a permanent pump is provided." Again, in speaking of the safety lamp we read "a gauze containing 20 wires per linear inch will be sufficiently fine." Again on the transport of coal, it says "when the coal is got...it is put into baskets or trucks...at the bottom of the shaft the coal is transferred to the square tubes which are made to fit the shaft." In conclusion, it says that "we have, for the sake of avoiding confusion, taken as our model one of the large collieries such as are found in the Newcastle coal-field." If this be technical education, the less we have of it the better. Then again other technical educators tell us the different values of a ton of pig-iron, of pins, of hair springs for watches; how many pins there are in a ton, &c., &c. Another class tells us how many matches are used in a day by every man, woman or child. Is this technical education? The matter could be extended *ad infinitum*, but our technical educators might at least define what they mean by technical education.

A very curious fatal accident is described in Jem Willis' last Annual Report, as an Inspector of Mines. Deceased and his mate were driving an under-level stone drift: they had drilled a fast shot in the face, pointing downwards, and near the bottom. The whole was charged with  $1\frac{1}{2}$  pounds of blasting powder, and after the fuze was ignited, the men retired to a distance of about 70 yards, deceased being furthest away. On the explosion of the shot, a stone weighing about 100 pounds was thrown about 73 yards. In its flight, it passed through a ventilating door at 50 yards, it struck the wall side at 56 yards, it passed one man and struck the deceased at 70 yards from the face. The accident was of an extraordinary and totally unexpected nature. If any of your readers work out the problem of its flight, and the highest point (in passing the door) being taken at 4 feet, it will be found that the efficiency of the powder in this case exceeded that obtained in the best modern Artillery.

\* [This newsletter, and other matter yet to be produced, have been several weeks in type owing to the pressure on our space.—Ed., I. E.]

THE telegraphic system of England has been brought to the highest pitch of perfection. We have neither neglected the inventions of other countries, nor have we been chary of exercising inventive skill ourselves, and we have received our full meed of that reward which is always freely bestowed on a British Government official—neglect and abuse.—W. H. Preece.



## Official Papers.

## PRECIS OF SUPPLEMENTAL NOTE TO COLONEL TREVOR'S SCHEME ON THE RE-ORGANISATION OF THE DEPARTMENT.

It was proposed that pay of R. E's. who are S. E's. or Ch. E's. or who are in 1st or 2nd classes of the proposed incremental scale should be the same as that of C. E's. in the same ranks and their net Military pay. This proposal was made in view of the many temptations to R. E's. to sever their connection with the department when their services would be most profitable to it. It would not, however, be consistent with the principle of assimilating the emoluments of R. E's. and C. E's. This object could be more nearly attained if the Civil salaries of R. E's. were Rs. 100 per mensem less than those of C. E's., their net Military pay being drawn in addition.

The incremental scheme would not interfere with the various linguistic and professional examinations laid down in the Code. Increments might be withheld in case of failure to pass the necessary examinations within a certain time.

As regards the accruelement of increments while on leave it seems that the fairest general rule would be to allow all leave which counts for pension to count also as service for increments, if an officer's previous record shewed him deserving of the indulgence. In exceptional cases such as that of an officer's health breaking down under arduous work or trying exposure on duty and necessitating furlough on medical certificate in excess of what would count for pension, part or the whole of which leave might be allowed to reckon as service carrying increments.

There should be no temporary or officiating promotions from the 4th to the 3rd class of Engineers.

Officers of the 4th class may hold charge of Executive divisions or serve as Assistants. Officers of the 3rd class should never be required to serve as Assistants, but they may occasionally be called upon to hold professional charge of an important work under the administrative control of another of the same class.

Relative seniority among officers of the same class should not be recognised at all.

An officer appointed from the 3rd class to act for an officer of the 2nd class, who may be absent, or an officer in the 2nd class acting for one in the 1st should, in either case, if it be the first time he has been so appointed draw the minimum pay of the higher class for the 1st year. He should, however, be eligible to draw the increments of that class after each year of completed and approved temporary service just as though he were permanent in that class. On reverting to his own class he would draw the pay to which his length of service in that class inclusive of the time passed in the higher class may entitle him, just as if he had continued to serve in it during his period of temporary promotion to the higher class.

On being re-appointed at any subsequent period temporarily to the higher class, his pay would commence at the amount which he drew when he last reverted, and his increments would continue to accrue according to his total service in the class as if there had been no break or reversion.

On permanent appointment to the higher class an officer would count the whole of his previous temporary services in it for determining the amount of his initial salary, and subsequently towards future increments.

## PRECIS OF COLONEL TREVOR'S NOTE REGARDING THE PROPOSED REDUCTION OF PAY OF R. E'S.

This proposal is to be considered two ways:—(1) By comparing relative emoluments of C. E's. and R. E's. and (2) whether Government can with justice order a reduction of pay of R. E's. now in P. W. D.

If "emolument" includes the value of pensions and gratuities, and if the new scale of pensions is sanctioned, the desired assimilation in position of R. E's. and C. E's. is practically effected without cutting the net Military pay of the former. There are 151 R. E's. in Civil Branches of the department and 322 in all branches and in various appointments. Of the total, 40 per cent. are Indian R. E's. and the remainder Imperial R. E's. The former are rapidly disappearing and none will be left in 1898. The pensions of Imperial R. E's. are in no way dependent on their departmental service,\* therefore, I am not sure that in comparing emoluments of R. E's. and C. E's. the Military pensions of the former should be taken into account. It would be manifestly unfair to consider the Indian's R. E. pensions, as this class is fast dying out.

On average, the R. E. joins the P. W. D. at 23 years of age and a C. E. at 22 years. Assuming that both enter as 2nd grade Assistants the C. E. will always have a year's advantage over the R. E. The rate of promotion is adopted from General Hannington's tables, assuming Secretary of State's new proportions of grades and classes and compulsory retirement of C. E's. at 50 and of all at 55.† The C. E's. pensions are taken on Secretary of State's new Despatch, and are commuted at 4 per cent. In assessing the R. E's. pensions a proportionate deduction is made for 3 years passed at home before joining as this is not service‡ in the P. W. D. Also enhancement of R. E's. salaries for any anti-departmental service has been omitted. It is then shewn in tables that up to end of 16th year, the C. E's. have rather the best of it, while after that period the advantage lies with the R. E's. In short, the conclusion is that if the Military pensions of R. E's. are excluded § while C. E's. get the new pensions, the C. E's. are better off than the R. E's. with their net Military pay added; while if the R. E. pension is counted the R. E's. have rather the best of it.

It therefore appears that the C. E's. have no grievance. But if the solution does not commend itself to Government, either the R. E.

must get some allowance in lieu of their net Military pay, or leaving them their net Military pay, the C. E's. must be granted some compensating allowance.

If any C. E's. have agitated for the reduction of the R. E's. pay it is not merely from empty jealousy, but from feeling that the resistance to the proposal to "level down" would be a powerful aid towards the levelling up which they have at heart.

The R. E's. now in the P. W. D. would consider the cutting of their pay as a sop thrown out by Government to obtain a passing relief from the disquietude caused by appeals made by C. E's., but wholly ineffectual for putting an end to the agitation or satisfying C. E's. The R. E's. now in the P. W. D. may with justice urge that they entered the department on certain conditions\* and on the faith that these would be fulfilled. If their pay is cut, it is not only contrary to precedent and the usual practice of Government, but an undoubted hardship and of very questionable justice. If a financial crisis were impending the R. E's. would without a murmur acquiesce to any reduction of pay, but merely to allay a jealousy such virtue would be superhuman. If the C. E's. pay cannot be raised to the same level as that of R. E's. the levelling down can at least be carried out gradually and only be made to apply to officers entering the P. W. D. in future. But even with addition of net Military pay, the emoluments of R. E's. are not on average so high as S. C. men in regimental employ, and their pensions are worse. The younger R. E's. at present shew no alacrity to join the P. W. D. If Civil employ is made so distasteful, the finances will be hardened by the cost of 150 R. E's. doing general duty. On average the cost of employing 100 R. E's. with their net Military pay would be the same as that of 34 C. E's. with their new pensions, if it is indispensable to maintain the R. E's. at their present strength as part of the Military garrison. Thus every R. E. in Civil employ costs  $\frac{1}{3}$  of a C. E. Again the cost of an R. E. doing Military duty on Indian pay and pension is to C. E. and new pension nearly as 2 to 3. Thus if Government dispensed with 150 R. E's. they could only substitute 100 C. E's. at the same cost. Therefore if the R. E's. are driven out of P. W. D. it will cost Government a great amount. In short, by taking what at first seems the most economical step towards compliance with a sentimental and persistent cry for equality, Government will ultimately have to pay much higher. If there is a grievance to redress Government should doubtless redress it promptly and effectually, but to create another grievance is scarcely expected, or a satisfactory solution. Whether C. E's. have any real and tangible grievance must be a matter of opinion. "So far as a grievance is capable of assessment, it is possible to apply a pecuniary remedy, but when it is merely the outcome of a sentiment which has no more substantial basis than that every man is as good as his neighbour and better, there is no finality to its claims. The more that is conceded to it the more it craves. It behoves Government therefore to be careful to distinguish between those claims which are reasonable and remediable and those which no liberality can satisfy." If the object is to silence the complaints of C. E's. not even putting them at a decided advantage all through their service will be effectual. There are other and higher standards of pay than that of the R. E's. which will be open for comparison and form a ground of complaint.

"That they will never desist from agitation until they have succeeded in substantially improving their pecuniary position and being at least as well remunerated as the R. E's. I have no doubt whatever; and that they will ultimately succeed may, I think, be safely assumed from what they have already achieved.†"

Government had therefore better make a merit of a necessity than yield grudgingly under pressure. The cost of the concession to Government would only be an average addition of Rs. 7,500 per mensem to every hundred C. E's. If this allowance be granted for length of service only independent of rank, the incidence of the charge would not be so heavy at first.

To prevent misunderstanding it is distinctly to be understood that no immediate increase of pay to C. E's. is advocated, as it is believed that the enhanced pensions virtually establish the desired equality between R. E's. and C. E's., but "it is scarcely to be expected that the concession, handsome and adequate though it be, will satisfy all the hopes raised by the conciliatory spirit!!!! in which the clamour raised on their behalf has been met by the home Government."

It may be accepted "as a foregone conclusion that the Government will in the long run have to yield to the organised importunity of the C. E's. backed as it appears to be by the influence of the entire profession at home, and bring their emoluments up to the same level as those the R. E's. now enjoy.‡"

Signed by COL. TREVOR'S INITIALS.

## The Gazettes.

## PUBLIC WORKS DEPARTMENT.

Burma, December 15, 1888.

Mr. H. O. Walling, Assistant Engineer, 1st grade, (Chindwin Division, passed the colloquial test in the Burmese language on the 17th November 1888.

Mr. A. C. Martin, Overseer, 1st grade, Chindwin division, passed the colloquial test in the Burmese language on the 5th November 1888.

Mr. W. E. Muntz, Assistant Engineer, 2nd grade, reported his arrival at Rangoon on the afternoon of the 12th December 1888 on return from the fifteen months' sick leave granted him. Mr. Muntz's services are placed at the disposal of the Superintending Engineer, III. Circle, for employment on the Shan Hills Road.

\* So did the C. E's.

† This is quite in line with the news from England. It shews Simla thinks that the C. E's. must win in the long run.

‡ Since annihilated by exchange.

\* They draw the pension as a reward for service in the P. W. D. why not count it?

† Note C. E's. retired at 50 and R. E's. 55.

‡ Now reckoned as service.

§ Why exclude them?



**Hyderabad, December 15, 1888.**

Mr. A. F. Higgins, Executive Engineer, 2nd grade, is, on return from furlough, posted to the charge of the South Berar Division at Yeotmal.

**Madras, December 18, 1888.**

Mr. R. Ry. S. Subbarayachariyar Avargal, Rai Bahadur, B.C.E., Executive Engineer, 3rd grade, sub. *pro tem.*, is granted leave on medical certificate for six months from the 27th November 1888.

**Punjab, December 20, 1888.**

Mr. F. W. Maunsell, Assistant Engineer, 1st grade, is promoted to Executive Engineer, 4th grade, temporary rank, with effect from the 24th October 1888, *vice* Mr. H. J. Johnston, proceeded on furlough.

Mr. E. S. Farrant, Executive Engineer, is, on return from deputation to the Kashmir State, posted to the charge of the Lahore Provincial Division.

**Bombay, December 20, 1888.**

Mr. D. W. Herbert, Assistant Engineer, 1st grade, is allowed twelve months' furlough, with the usual subsidiary leave, from 20th January 1889, or such subsequent date as he may avail himself of it.

**Assam, December 22, 1888.**

Mr. E. J. Mitchell, Assistant Engineer, 1st grade, who was transferred to the Naga Hills Division in orders dated 20th November 1888, reported his arrival at Golághát on the forenoon of the 28th ultimo.

**N.-W. P and Oudh, December 22, 1888.***Irrigation Branch*

Mr. N. F. McLeod, Assistant Engineer, 1st grade, is, on return from furlough, posted to the Northern Division, Ganges Canal.

**India, December 22, 1888.**

Mr. G. A. D. Anley, Superintending Engineer, 2nd class Bengal, retired from the service, with effect from the 16th November 1888.

Mr. L. R. Roberts, Executive Engineer, 1st grade, Bengal, retired from the service, with effect from the 7th October 1888.

Mr. G. C. F. Barnardo, Executive Engineer, 3rd grade, North-Western Provinces and Oudh, is granted special leave for one year and nine months, under the terms of Public Works Department letter, dated 3rd October 1888, with effect from the 25th September 1888.

Mr. R. D. Bayley, Executive Engineer, 1st grade, Punjab, retired from the service, with effect from the afternoon of the 12th December 1888.

Major F. Firebrace, R.E., Consulting Engineer for Railways, Bombay, on return from furlough, on the 10th November 1888 resumed the rank of Superintending Engineer, 1st class, sub. *pro tem.*

The services of Mr. B. K. Finnimore, Executive Engineer, 4th grade, temporary rank, Bengal, are placed at the disposal of the Foreign Department, with effect from the afternoon of the 17th October 1888, for employment in the Nipal State.

*Military Works Department.*

The services of Major W. H. Haydon, R.E., Executive Engineer, 1st grade, Karachi Defence Division, are replaced at the disposal of the Government of Bombay, with effect from the 17th November 1888.

Lieutenant W. W. Baker, R.E., Assistant Engineer, 1st grade, is promoted to Executive Engineer, 4th grade, temporary rank, with effect from the 17th November 1888, the date on which he received over charge of the Karachi Defence Division from Major W. H. Haydon, proceeding on furlough.

Lieutenant W. G. R. Cordue, R.E., Assistant Engineer, 2nd grade, is appointed to officiate as Executive Engineer, Peshawar Division, Military Works, with effect from 1st December 1888.

Captain H. W. Duperier, R.E., Executive Engineer, II. Pishin Division, is placed in charge of the I. Pishin Division, in addition to his own duties, during the absence of Captain H. H. Hart, R.E., Executive Engineer, on three months' privilege leave.

**Bengal, December 26, 1888.**

Rai Haran Chunder Banerjee Sahib, Executive Engineer, in temporary charge of the Burdwan Division, is transferred to the Chittagong Division.

With reference to the notification of this Department, of the 29th ultimo, Mr. E. B. Gardiner, Executive Engineer, is appointed to hold charge of the new Burdwan Division.

Mr. W. P. Milne, Executive Engineer, is transferred from the Assam-Bihar State Railway to the Western Bengal Railway Surveys.

**Indian Engineering Patent Register.****The 20th December 1888.**

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act V. of 1888, in the Office of the Secretary to the Government of India in the Revenue and Agricultural Department:—

22 of '88.—Albert Henri Jacques Bergé of Brussels in the Kingdom of Belgium, Engineer. —For improvements in the acid saccharification of amylaceous substances.

85 of '88.—George Walshe, Military Pensioner, Seamen's Institute Bombay. —For a Bullock Yoke.

125 of '88.—Charles Albert Knight of the Babcock and Wilcox Company, 107, Hope Street, Glasgow, Scotland, Engineer. —For improvements in steam boilers.

130 of '88.—The Farbenfabriken vormals Friedrich Bayer and Company, of Elberfeld in the Empire of Germany. —For improvements in the manufacture of Azo dyes.

**Advertisements.****D. P. W. India.****IMPORTANT NOTICE.**

All Civil Engineers of the Department are informed, that, owing to the extended support accorded to the Civil Engineers' Association, the Committee feel it necessary to still further widen their sphere of influence, and to delegate some of their duties.

The current work has been entrusted to Local Sub-committees, who will correspond with the Central Committee.

Every Civil Engineer is urged to write to the Hon. Sec. c/o Grindlay, Groom and Co., Bombay, who will put him in touch with his Sub-committee, with the view of enrolling him a member of the Civil Engineers' Association.

**MILLWRIGHT AND ENGINEER.**

WANTED on the West Coast a good practical man to erect Paper Mill Machinery, gearing, and Turbine. Send full particulars with salary expected to—

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(221)

QUILON.

**SIND ARTS COLLEGE, KARACHI.**

A PROFESSOR of Engineering will shortly be appointed. Salary Rs. 150 per mensem.

Applications will be received up to the 4th January 1889 by the

HONORARY SECRETARY,

(220)

SIND ARTS COLLEGE BOARD.



# INDIAN MIDLAND RAILWAY.

## NOTICE.

**T**HE Section from **Jhansi to Bhopal** of this Railway will be opened for public traffic of all descriptions on and from the 1st January 1889.

From the same date the **Bhopal State Railway** will be worked as part of the **Indian Midland Railway** system.

Through Passenger trains over the Indian Midland Railway will be run daily between Itarsi on the Great Indian Peninsula Railway and Cawnpore on the East Indian Railway.

The Local mixed trains between Jhansi and Cawnpore will be continued. The local trains between Itarsi and Hoshungabad Station will not be run after the 31st instant.

**Time and Fare Notices**, also a book of General Rules and Rates for the Conveyance of Passengers, Luggage, Parcels, Horses, Carriages, &c., with the Goods tariff containing the classification of goods will be published shortly.

A. C. CREGEEN,  
*Agent and Chief Engineer.*

JHANSI; }  
24th December 1888. } (223)

## NOTICE.

District Board Engineer.

**W**ANTED an Engineer for the District Board, Nellore, Pay Rs. 400, rising by annual increments of Rs. 50 to a maximum limit of Rs. 550 with Travelling allowance at Rs. 4 per diem. Preference will be given to a European. Applications with copies of testimonials to be submitted to the undersigned.

(222) C. D. MACLEANE,  
COLLECTOR & PRESIDENT.

# SOUTH INDIAN RAILWAY, VILLUPURAM-DHARMAVARAM EXTENSION.

To Petty Contractors for the Supply of Labour and Building Material, &c., &c.

1. About 300 miles of new Railway construction have been started from Villupuram through Terivannamali, Vellore, Chittoor to Tirupati and Dharmavaram.

It is intended to carry out the work as far as possible on the Departmental or Petty Contract system, and the attention of Petty Contractors for Labor and Materials is invited to the undertaking.

2. Proposals will be received and information given as to work, rates, &c., &c., on application to the undersigned or to the Engineers on the works

To Upper and Lower Subordinates.

3. Subordinates such as Sub-Engineers, Masonry Inspectors, Surveyors, Supervisors, Overseers, and Maistries, well experienced in works of Railway Construction are required. Applications should be forwarded prepaid to the undersigned, giving age, race, full details of experience, reference to previous employers, copies of certificates, salary last or now received and expected.

DAVID LOGAN,  
CHIEF ENGINEER,  
*South Indian Railway.*

CHIEF ENGINEER'S OFFICE; }  
TRICHINOPOLY; December 8, 1888. } (215)

## WANTED.

**A** GOOD secondhand self-turning and moving Steam Crane to lift 4 tons, mounted on carriage to run on 5'-6" gauge rails; also a Hand Crane to lift the same load, similarly mounted.

State price and place of delivery to—

CHIEF ENGINEER,  
MADRAS RAILWAY COMPANY,  
*Royapuram, Madras.*  
(211)



## NOTICE.

**TENDERS** are invited for painting about 6,000 'tons of ironwork on girder bridges. Tenders should reach the office of the undersigned not later than the 15th of January 1889. The work to be completed by the 1st May 1889.

G. VIBART,  
FOR AGENT & CHIEF ENGINEER,  
*Southern Mahratta Railway,*  
Dharwar : } *Dharwar.*  
12th December 1888. } (218)

## "THE NAHAN SUGARCANE MILLS."

These Mills have metal frames. The rollers are of close grain hard cast-iron, cast under pressure and have stood rough usage for years.

Every portion of the Mill is made to gauge so that should any part require renewing it is only necessary to send to the nearest Agency for it, where a duplicate can be procured with the certainty of its fitting.

It requires less power to drive than others.

At every Public Exhibition where the "NAHAN MILL" has been exhibited, it has extracted more juice than any other Mill.

For price lists and other information apply to the

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**THOMSON & MYLNE'S**  
**PATENT SUGARCANE MILLS.**  
For particulars of Depots, Licensees, &c., address—  
**THOMSON & MYLNE,**  
BEHEEA, E. I. RAILWAY;  
or 6, Commercial Buildings, Calcutta.  
(103)

**CREAT WESTERN HOTEL,**  
[29] **BOMBAY.**

## FOR SALE.

**GIRDER** Erecting Staging capable of erecting Girders up to 200 feet span. Also Portable Engines, Centrifugal Pumps, B. G. Rolling Stock, and other Engineering Plant.

For full particulars apply to—

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*Gwalior, C. I.*

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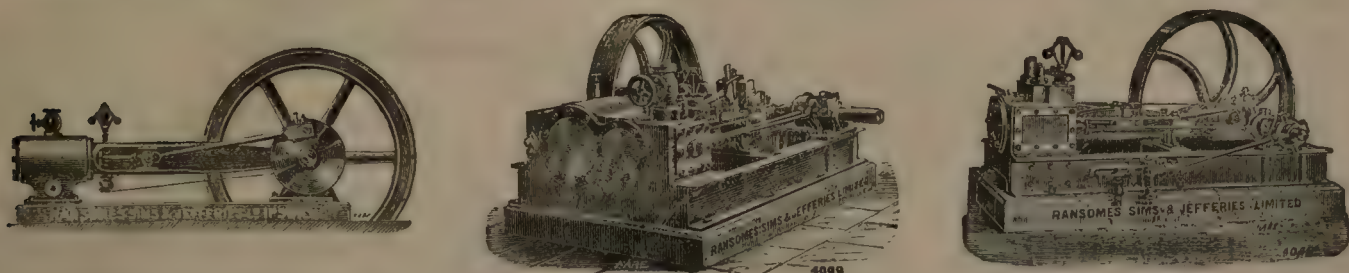
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**HIGHLAND WHISKY.**  
Rs. 25 per dozen.

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Babbit's Metal and Richard's Plastic Metal.  
Regulus of Antimony, Pure Block Tin.  
Pig and Sheet Lead, Muntz Metal Rods and Sheets.  
Brass and Copper Rods, Tubes and Sheets.  
Zinc Sheets and Tin Plates.  
Best Tool and Miners' Steel.  
Spring Steel selected, and mild Steel Sheets.  
Lowmoor, Farnley, and best Staffordshire Bar and Sheet Iron.  
Plain, Galvanized, and Corrugated Iron Sheets, Ridging and Gutterings.  
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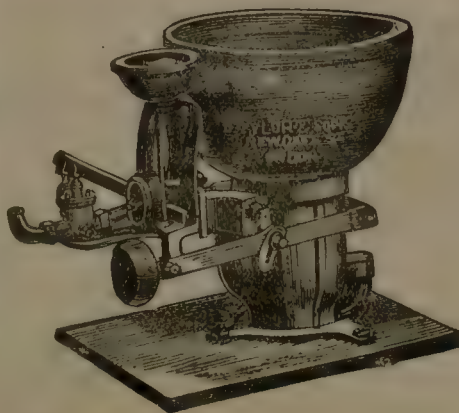
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Mechanical Engineer,  
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Cast-iron Flange Pipes, of ordinary dimensions, tested up to a pressure of 250 feet of water, with faced joints and drilled bolt holes, coated with Dr. Angus Smith's solution	...	" 5-12 "
Cast-iron Bends, Tees and Cross Pieces for Pipings of ordinary dimensions coated with Dr. Angus Smith's solution from	...	" 7-0 " upwards.
Cast-iron Fire-bars, Floor-plates, Plain Columns, &c., from	...	" 5-0 " "
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Cast-iron Ornamental Columns railings, gates, spiral staircases, porticos, brackets, arch-fillings, &c., in great variety	...	At cheapest rates.
Cast-iron Rammers, Road Rollers Garden Rollers, Sugarcane Rollers, Rain-water Pipes, Axle-boxes, parts of machinery and other castings of any description	...	At cheapest rates.
Water-lifts	... from Rs. 35-0 each, and upwards.	Foundry Pig Iron No. 1 ... " 45-0 per ton.
Ploughs	... Rs. 4-0 each.	Ditto No. 2 ... " 42-8 "
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Telegraphic Address—"SILVERGRAY," CALCUTTA.

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*Extracts from the Twenty-sixth Annual Report viz. for the year 1887.*

FIRE DEPARTMENT.	LIFE DEPARTMENT.	MARINE DEPARTMENT.
Premiums after deducting	Premiums after deducting	Premiums after deducting
Re-insurances ... £769,265 0 0	Re-insurances .. £125,559 0 0	Re-insurances ... £175,118 0 0
Interest ... £ 19,612 0 0	Interest and Dividends ... £ 45,649 0 0	Interest ... £ 8,294 0 0
Losses after deducting Re-insurances ... £443,587 0 0	Claims less Re-insurances, £ 79,229 0 0	Losses after deducting Re-insurances .. £138,365 0 0
		Interest not belonging to above, but included in Profit and Loss .. £ 18,545 0 0

**The Life Fund was increased during the year by £65,643 and now amounts to £1,070,064.**

The Life Funds of the Company are held in special trust by Deed of Settlement and Act of Parliament, and are only liable for Life Claims. Life Policies also share with the other contracts of the Company in the security afforded by the General Funds (over £1,400,000) and the uncalled Capital of £2,250,000.

The rates of Premium are moderate, but they are not unsafely low, and will be found to stand the test of time, thereby in conjunction with the ample Funds affording absolute security to the assured.

The Total Funds and property in hand on 31st December 1887 stood at £2,613,059.

(39)

C. H. OGBOURNE, *Manager and Underwriter.*

## PURE HYDRAULIC LIME.

### FREE FROM ADULTERATION.

Numerous favourable certificates of the quality of our manufacture have been received, and the following are fair selections:—

J. H. APJOHN, Esq., Superintending Engineer, Kidderpore Dock Works, says:—

"Mr. McKennie's test for purity applied at Raneegunge shewed that it contained only 22 per cent. of insoluble matter, or only 3rds of the impurity allowed; there can be no question but that it is of very superior quality."

PAUL DESJOUX, Esq., Executive Engineer, Government Cement Experiment Division, reported:—

"It is the best Ghooting Lime imported into Calcutta."

JAMES KIMBER, Esq., M.I.O.E., Engineer to the Corporation of Calcutta, says:—

"It has been for long past and is now invariably used in all works, particularly drainage works. I have much pleasure in certifying to the excellent and reliable quality of the Lime."

O. A. MILLS, Esq., Executive Engineer, P. W. D., 2nd Calcutta Division, says:—

"The Ghooting Lime manufactured by Messrs. Burn & Co. is better than any that can be purchased in Calcutta. I have used it in the construction of many public buildings and have been thoroughly satisfied with it."

N.B.—Our Lime was used throughout all the River Works of the Calcutta Port Commissioners.

## BURN & CO.,

(179)

7, Hastings Street, or Raneegunge.















